EDITORIAL

WITH the publication of this issue, "Radio, Television and Hobbies" completes its first twenty years of existence.

It came into being as the natural successor to "Wireless Weekly," which with the rapid expansion of radio and electronic arts, had proved inadequate to cater fully for its technical readers. "Wireless Weekly," as many of the older brigade will remember, was first published in 1922. Thus, our full pedigree goes back for 37 years, a period which covers the complete history of broadcasting in this country, and even beyond it.

I well remember the eagerness with which we launched our magazine in its monthly format, and our excitement when we found that not only had we outsold any previous competitor many times over, but were forced into a reprint to meet the demand. I wonder how many magazines have been as fortunate as this?

Our 20 years of life have not always been easy. Shortly after they began, we entered into the long years of World War II, which not only shattered all our plans, but even threatened our existence. Even when the war was over, there were paper rationing and supply shortages to hold us back.

Since 1939, vast changes have come over the radio scene, so much so that the pattern of experimental and home building of equipment has completely altered.

As each new development came along, our task has been to examine it, learn about it, and find some way of simplifying its complications so that our readers could share in the movement of progress.

Perhaps the most difficult task of all came with TV.

Fortunately we were able to solve its problems so successfully that our TV designs have been duplicated almost in thousands, and have, I think, played no small part in educating experimenters and technicians in the complexities of a new electronic world.

I think we can face the future with every confidence of continued success, which has been, and will be, due largely to the remarkable loyalty of our many readers, and the faith which our advertisers have in us.

The years ahead are likely to be embarrassing with the wealth of material they will bring. The next 20 years should be no less stimulating than the last, and although it is now 31 years since I first began writing about radio, I hope I will make the grade with you when our fortieth birthday comes around.

John Moyle

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OUR COVER PICTURE

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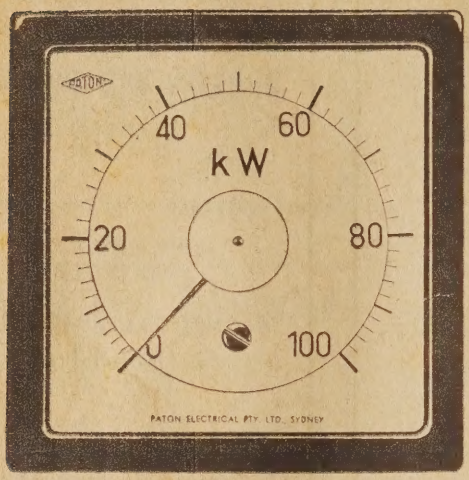

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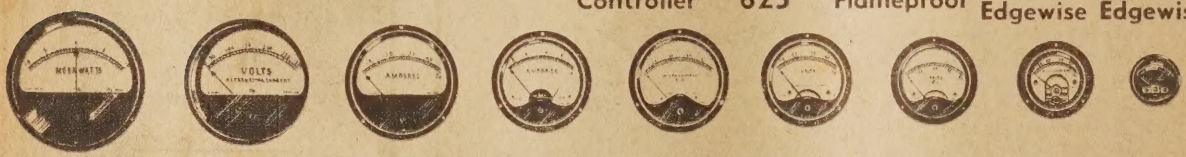

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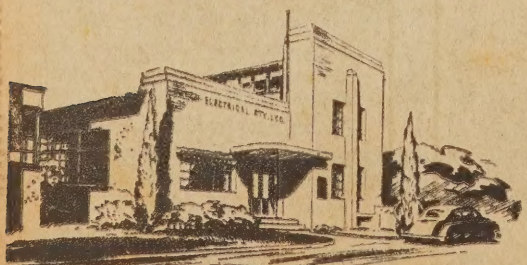

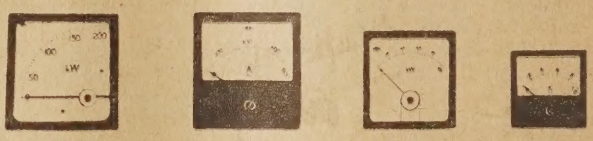

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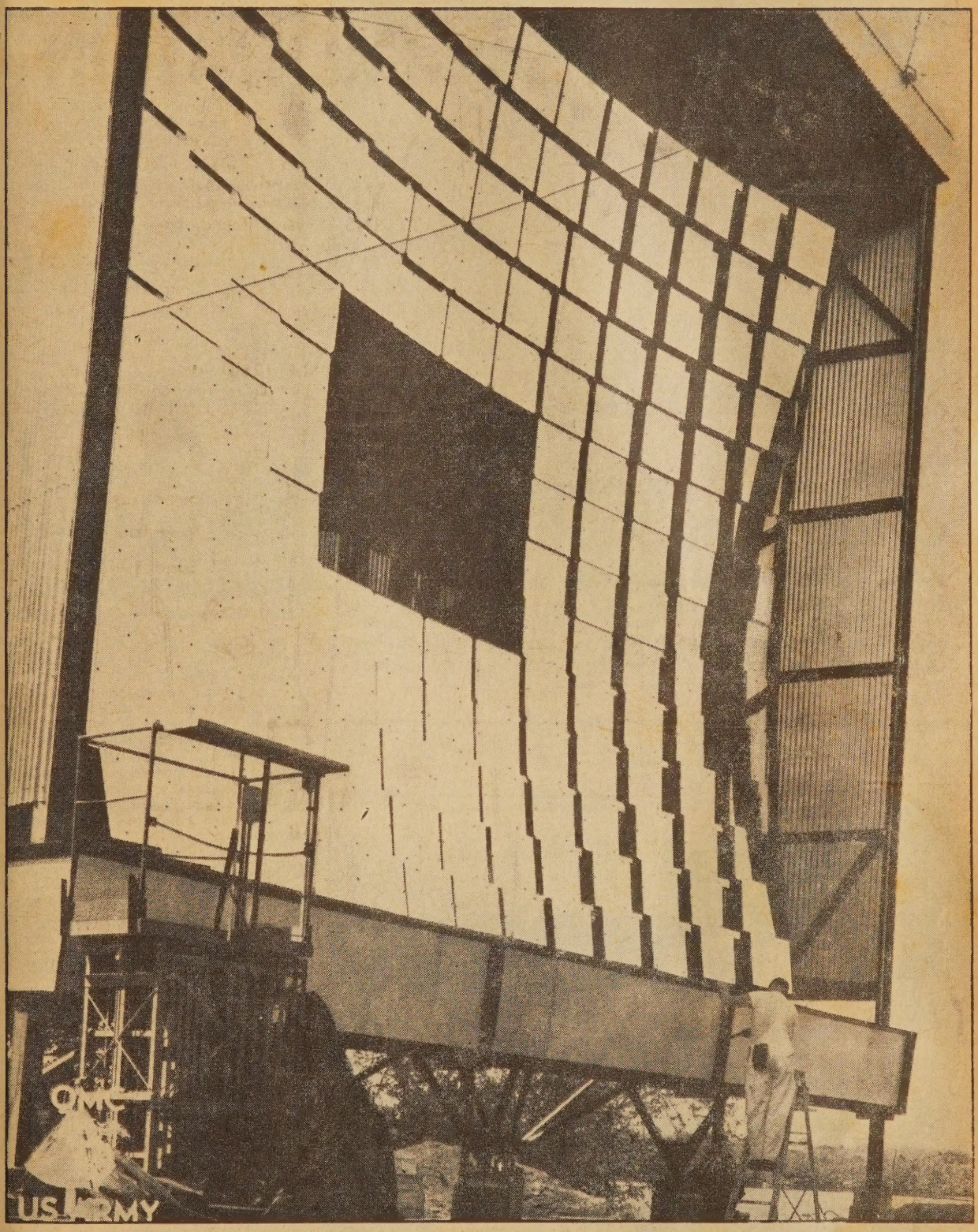
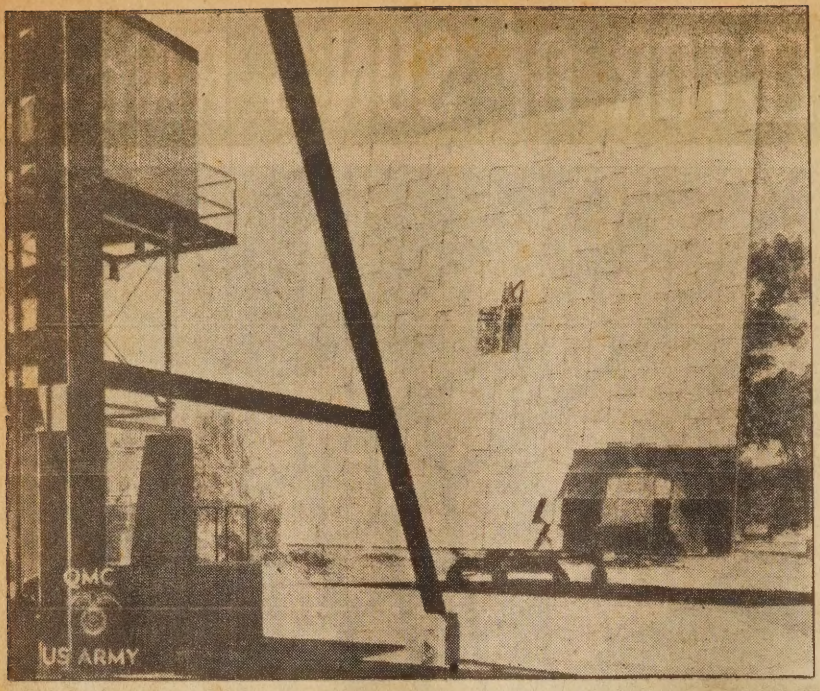
HUGE COLLECTOR OF SUN'S RAYS



The concentrator of the solar furnace (see story overleaf) uses 180 concave mirrors, which superimpose the reflected polar radiation into a four-inch area in the test chamber. Temperatures of 4,000-5,000 Fahrenheit can be obtained by these means.



An impressive view of the huge heliostat, 40ft wide and 36ft high, which contains 355 mirrors. On the year's longest day, eight hours of useable solar radiation can be produced. This picture was taken almost at the foot of the attenuator. The test chamber can also be seen here.

Solar Furnace Can Melt Steel

The power which the sun pours into the earth in the form of heat is tremendous and, because it involves no outlay on our part, presents many advantages as a source of power. Unfortunately the structures required to use the sun's power are large and awkward, but results can be spectacular. The apparatus described here can produce enough heat to melt bars of steel.

THE U.S. Army Quartermaster Research and Engineering Command conducts continuous studies to develop protection for the soldier against the thermal radiation of nuclear and other weapons. These studies require a source providing a high, uniform intensity over a large area. Available sources, such as high-current carbon arcs, gas-fired panels, burning magnesium, and incandescent lamps, are not adequate.

REQUIREMENTS

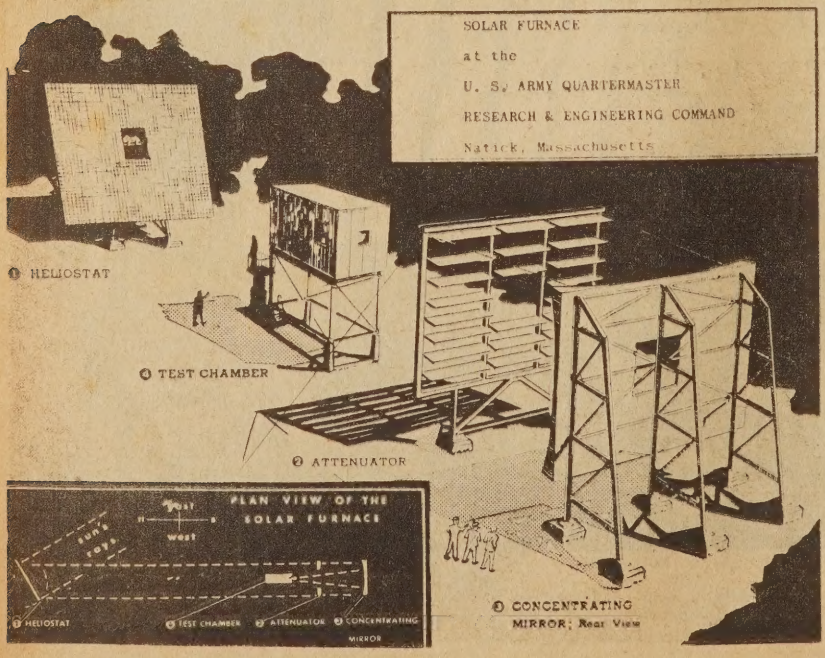
The solar furnace, at the Quartermaster Research and Engineering Centre, was constructed to provide a source meeting these requirements reasonably well. These include: an area large enough to produce realistic flaming materials and at least an approximation to one-dimensional heat transfer conditions, and a flux high enough to produce destruction of materials and burning of protected skin with exposure times of much less than one second. The minimum requirement was set at 60 cal/sq. cm. sec over a circular area 4 inches in diameter in a vertical plane.

The furnace will concentrate radiation from the sun and focus the concentrated energy to form an image of the sun. Samples of materials under investigation will be placed at this focus to study their behaviour when exposed to the beam for specific periods.

Although the solar furnace is designed for high thermal flux rather than high temperature, a sample exposed for a sufficient time should be able to reach 5,000 degrees Fahrenheit at the image position.

The Quartermaster installation, the largest in the United States, covers about 125 by 40 feet of ground space. It consists of four main elements: the heliostat, the concentrator, the attenuator, and the test chamber.

An artist's sketch showing the general arrangement of the components which make up a solar furnace.

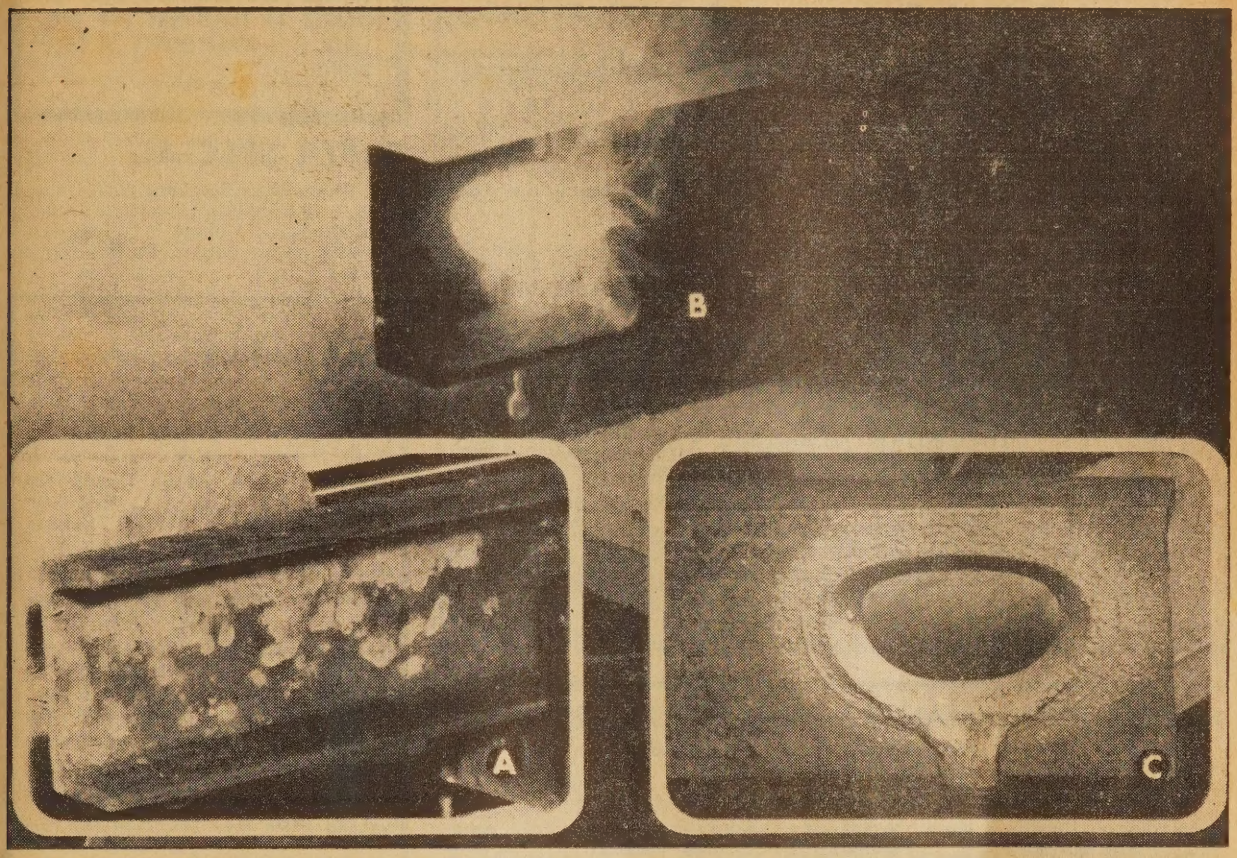


ARRANGEMENT OF UNITS

In operation, solar radiation falls upon the heliostat (1). This radiation is reflected to the concentrating mirror array (3), where the radiation is intensified, and directed into the test chamber (4). The attenuator (2), is a venetian-blind type device which regulates the amount of light reflected from the heliostat. An opening in the attenuator permits the concentrated beam to pass into the test chamber.

The heliostat, consisting of 355 mirrors, each 2 feet by 2 feet, is 40 feet wide and 36 feet high. It can be positioned at any angle required to reflect the sun's radiation along the axis of the furnace. Each mirror, made of one-quarter-inch water-white plate glass silvered on the back can be adjusted by optical means to give an overall flat surface.

CONCENTRATED SUN POWER MELTS HOLES IN STEEL



This remarkable picture illustrates the great heat generated by the solar furnace. "A" shows a piece of steel I-beam before exposure to the radiation. At "B" the four-inch ray concentrated from the 180 mirrors of the concentrator rapidly flames through the tough metal. "C" shows an elliptical hole, which has been burnt in the metal. A temperature of up to 5,000 degrees Fahrenheit can be reached.

The basic requirement placed upon the heliostat is that it maintain the reflected beam in a fixed position parallel to the principal axis of the concentrator. The heliostat mounting is similar to those utilised for radio telescopes and radar antennas.

The concentrator frame is approximately 30 by 30 feet. It mounts 180 spherical mirrors, each about 2 feet by 2 feet. The mirrors are adjusted independently to focus at the same point. The effective concentrating surface has an area of 766 square feet.

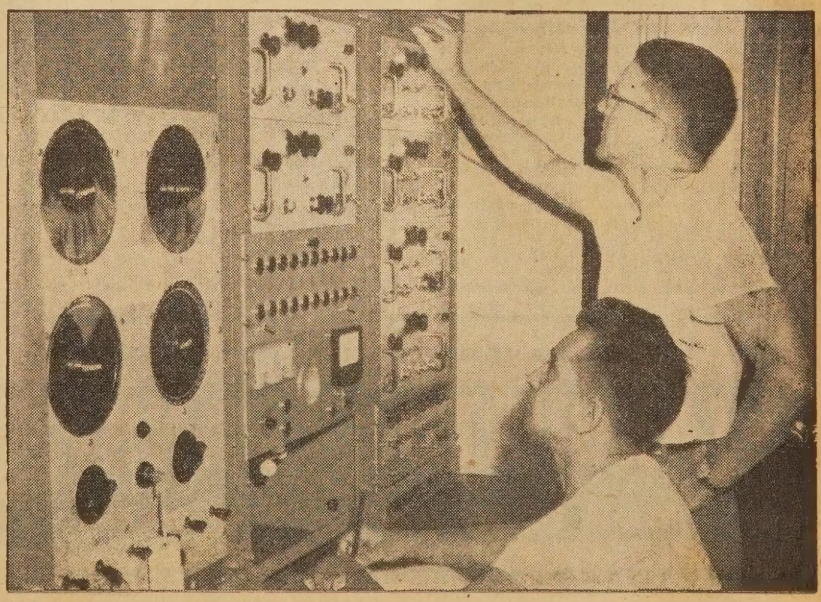
DETAILS OF MIRRORS

The size and shape of the concentrator mirrors permits close fitting, and simplicity of manufacture. Each mirror is mounted on an aluminium ring 23.5 inches in diameter. The ring adds symmetrical rigidity, and provides support for fastening the mirror to the framework and for adjusting the angle of inclination to the incoming beam.

The concentrator is located 96 feet south of the heliostat to avoid shadowing of the heliostat by the other components.

Openings have been left at the centre of both the heliostat and the concentrator, since beams from this area would be obscured by the test chamber.

The effective focal length of the concentrating surface is 35 feet, giving a 3.9-inch solar image in the test chamber, if perfectly imaged.



Centre of operations is this control room. From this room the position of the heliostat and setting of the attenuator vanes can be set. There are other adjustments, which set the speed with which the heliostat "tracks" the sun, an operation which is carried out automatically. Temperature indicators are also included.

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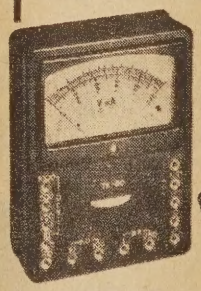

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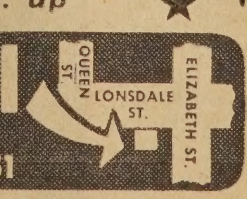

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In the test chamber, which is 8 feet by 8 feet in a cross section presented to the parallel light, and almost 16 feet in the direction of the beam, Quartermaster scientists and technologists will operate the heliostat control panel and instruments for measuring the effects on samples. The test chamber equipment includes a fast-exposure shutter, giving exposures as short as 0.1 second, and a water-cooled, protective shutter designed to shield the exposure shutter and sample until just before exposure is made.

The attenuator is used primarily to control the flux of radiation. The placement of the attenuator is such that it regulates the amount of parallel light from the heliostat, but does not interfere with the convergent beams from the concentrator. The blades of the attenuator can be adjusted from within the test chamber. The incoming parallel radiation can be monitored for intensity at any time, and the concentrated radiation measured by means of calorimeters and radiometers.

SAFETY FEATURE

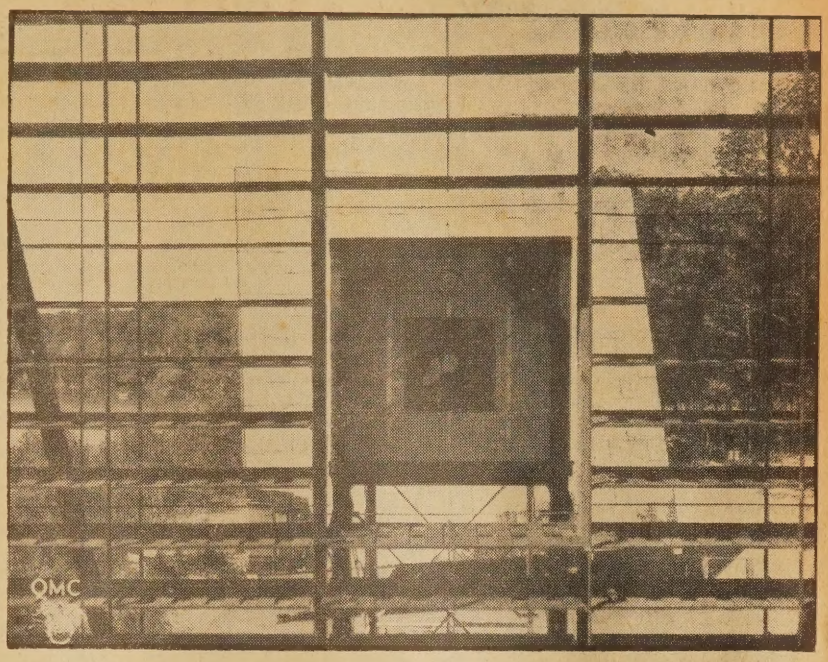
Equipment is provided for automatically closing the attenuator in case of power failure, incorrect tracking, excessive image movement, or other emergency. The operator will be able to close the attenuator suddenly if he deems it advisable to do so.

The test chamber is temperature-controlled. Access to the chamber is by means of an elevator.

The Quartermaster Solar Furnace is the first large furnace of the focusing type to utilise an effective aperture to focal length ratio of less than one. It will furnish valuable information on the effects of high intensity thermal radiation on materials and in addition may contribute to the general solar energy field.

The furnace, operating as of September 30, 1958, is located on the shore of Lake Cochituate, a calculated placement to allow for increased operability through the extended western horizon.

LATTICE DEVICE CONTROLS HEAT



The attenuator has 17 mechanically operated vanes, which control the amount of sun radiation passed from the heliostat to the concentrator. The venetian-blind type vanes open to full horizontal if required, but do not interfere with convergent beams from the concentrator. The vanes close automatically in case of emergencies. Seen through its centre is the test chamber.

COLOURLESS SLIDE HOLDS COLOUR PICTURE

LAST year, a colourless, transparent slide produced a full-colour photograph when projected on a screen. The demonstration illustrated a new technique for recording "colour information" in tiny ripples on a clear gelatine film, a technique that may have eventual importance in colour television for both home and theatre applications. The ripples in the film serve as a diffraction-grating system, and a special projector is used to "translate" the diffraction patterns — overlapping series of light waves —so that brilliant primary colours are projected on the screen at the same time.

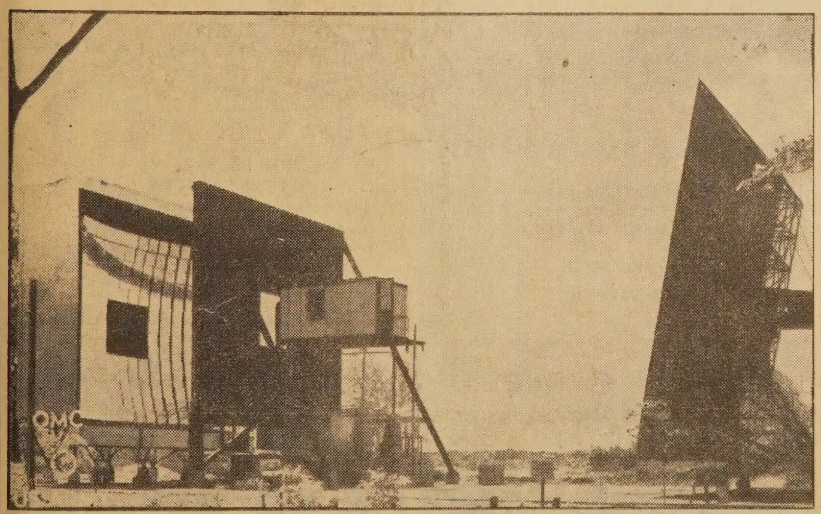
By placing a special mask in front of the film in an ordinary camera, colour photographs could be taken directly on black-and-white negative materials, although the technique has not yet been developed for wide use in photographs.

An unusual aspect of the system is that it makes possible a full-colour picture produced by two primary colours, one fixed and one variable, instead of the usual system of three fixed primaries. This "one-fixed-and-one-variable" method actually reproduces a greater part of the visible spectrum than the ordinary three-primary system.

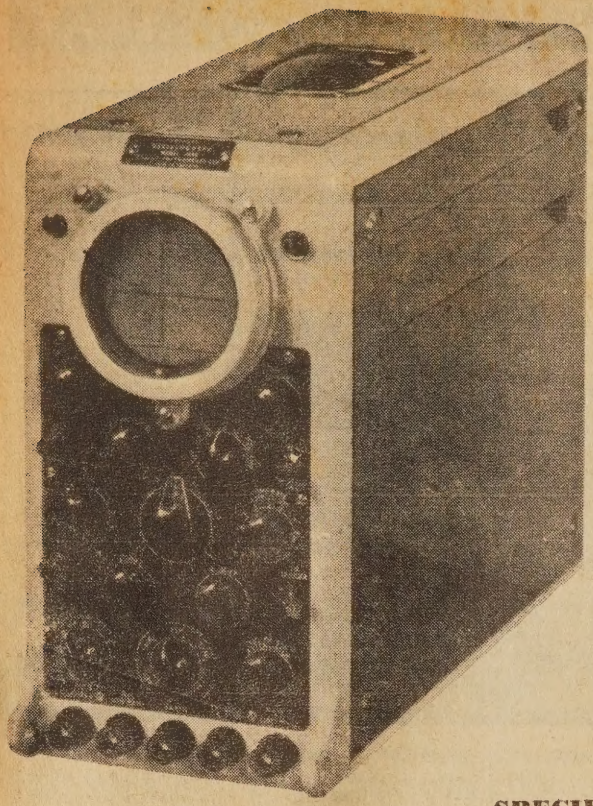
In the field of luminescence, some new observations on zinc sulphide layers activated by arsenic or phosphorus offer promise of devices for solid-state image storage. Under the concurrent action of high D.C. fields and incident radiation of various types (ultraviolet, blue, X-rays, or cathode rays) an electroluminescent output is established that persists for many seconds after the removal of the radiation.

The amount of light generated at each point on the screen is related to the intensity of the radiation impinging upon it, thus allowing reproduction of an image.

Storage of the image is currently incomplete, in the sense that its brightness decays slowly with time.



Low angle view of the solar furnace graphically points up its scope and components. From the heliostat (right) to the concentrator (far left) is roughly 100ft. The 180 concave mirrors of the concentrator focus the rays to a single point within the test chamber. In this picture the vanes of the concentrator are closed.



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This Model is used by TV manufacturers and technicians throughout Australia and is fitted with a 4in diameter P.D.A. tube and provides a display of 6 cm. amplitude from zero frequency to 6 Mc/s. It has a direct coupled Y amplifier with a sensitivity of 0.25 V/cm and accurate calibrating facilities and a symmetrical X amplifier. The time base is free-running or triggered and has a wide range of scanning velocity.

Synchronization or trigger is by positive or negative-going pulses (switch-selected) either externally applied or via the Y amplifier and a special facility is provided so that time base trigger can be achieved from either frame or line synchronization pulses in a 1 volt D.A.P. (positive) television signal. The X amplifier provides a sweep expansion of up to five times. Time calibration is provided and measurements are made directly upon a calibrated scale.

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Sweep expansion 5 times.

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Continuously variable trigger attenuator.

Time calibration by shift control (10 per cent accuracy).

Y AMPLIFIER

DC to 4 Mc/s (—30 per cent) and 6 Mc/s (—50 per cent).

Separate AC input terminal giving LF response 30 per cent down at 20 c/s.

Maximum sensitivity 1 cm deflection for not more than 250 mV input.

Minimum sensitivity not more than 1 cm deflection for 200V input.

Eleven-position input attenuator with ratios 1, 2, 5, 10, 20, 50, 100, 200, 500, 1000 and 2000, all plus minus 5 per cent.

Rise time not greater than 90 millimicroseconds. Overshoot not exceeding 5 per cent.

Input impedance 1 Megohm, 50 pF to 2 Megohms, 45 pF.

Voltage calibration by 0.5V plus minus 3 per cent DC source (at front panel).

X AMPLIFIER

20 c/s to 200 kc/s (—30 per cent) and 500 kc/s (—50 per cent) at min. gain.

20 c/s to 120 kc/s (—30 per cent) and 250 kc/s (—50 per cent) at max. gain.

Maximum sensitivity 500 mV/cm.

Gain control continuously variable over approximately 5:1 range.

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HIGH ALTITUDE STORMS

May Be Cause Of Airglow

THE airglow, that faint emission of light detectable at night in the upper atmosphere, appears to form "cells" of brightness, typically 1,500 miles across. According to results of observations published by F. E. Roach and others in Journal of Atmospheric and Terrestrial Physics (Vol. 13, p. 113 and p. 122) these cells move bodily across the sky at about 200 m.p.h. at the same time rotating, taking about five hours to turn once.

They seem to behave, in fact, in their own domain 60 miles or so above the Earth, very like the cyclonic storms of the lower air: they cover about the same area as a typical depression, but move faster.

The airglow has not been satisfactorily explained. It has to do with changes in the atoms and molecules of the upper air; but it cannot be ascribed, as would be the simplest theory, to the decomposing action of sunlight, because the effect would then diminish rapidly after sunset.

Roach and his colleagues suggest that the vortex motions of the upper atmosphere which they report is closely involved in the actual mechanism of the airglow. They mention possible effects on the electrical state of the moving gases of the Earth's magnetic field and of the wind-shear (the marked differences in wind velocity at different heights observed in studies of meteor trails).

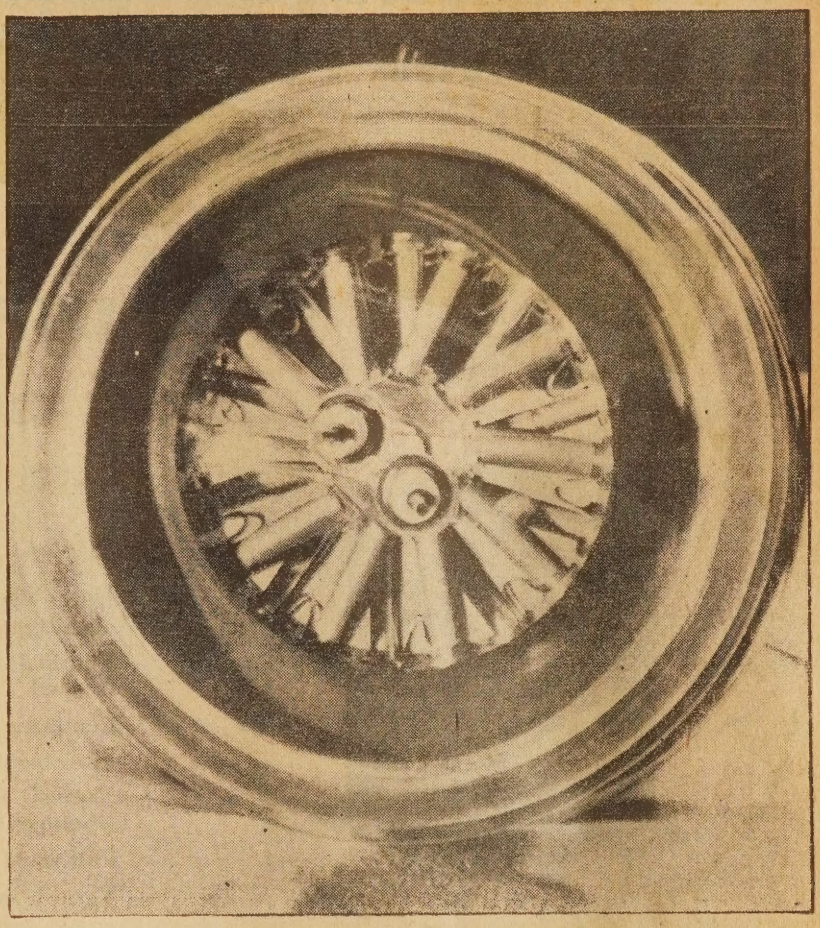
WEIGHTLESS ON EARTH

THE mental disturbances that may afflict space travellers when they find themselves weighing nothing for long periods of time can be tested here on Earth without the expense of building a rocket, according to Dr H. J. Muller, the Nobel prizewinning geneticist.

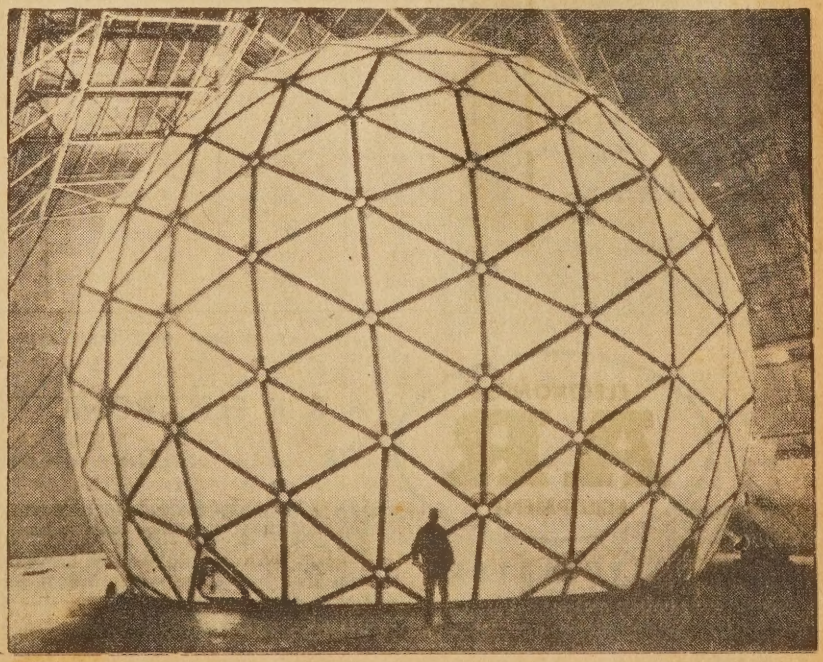
His proposal is that a man should be immersed lying down in salty water in which he neither sinks nor rises, and the tank should be rotated slowly about the line joining his head to his toes. The aim of the immersion is to remove differences of blood pressure in different parts of the body and the sensation of pressure on the feet or back associated with supporting one's weight against gravity.

By the slow rotation Muller expects to annul the direction-indicating effect of the semi-circular canals in the ears.

SMALL ATOM POWER GENERATOR



Not a new type of wheel, but a top view of a small atomic power plant unveiled last month in Baltimore. The spoke like arrangement of thermoelectric elements leading from the core contain a minute quantity of radioactive material. The plant, weighing five pounds, has a lifetime power equivalent of a ¾-ton dry cell.



Like a golfer's nightmare— ball too big, hole too small—what is described as the world's largest fibreglass radome dwarfs a spectator in the General Electric's missile detection systems section. The giant ball 68 feet in diameter and seven storeys high was built by Goodyear Aircraft Corporation to house radar detection equipment designed for the U.S. Air Force. It can be assembled or taken apart in eight hours by a six-man crew, and may be air lifted to any location.

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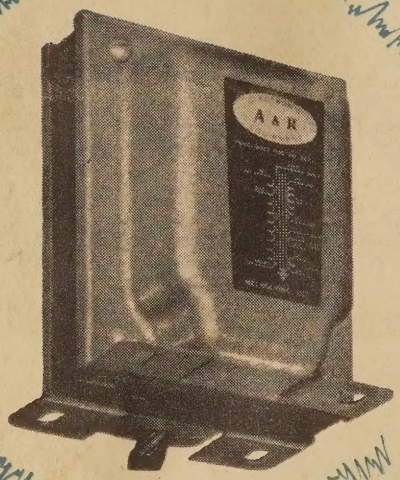

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PT1882	60	" " "	325	6.3V-1A Tap at 5V-2A; 6.3V-2A
PT1883	60	" " "	385	5V-2A; 6.3V-2A.
PT1884	80	" " "	250	6.3V-1A Tap at 5V-2A; 6.3V-2A; 6.3V-CT-2A
PT1885	80	" " "	285	6.3V-1A Tap at 5V-2A; 6.3V-2A; 6.3V-CT-2A
PT1886	80	" " "	300	6.3V-1A Tap at 5V-2A; 6.3V-CT-2A; 6.3V-CT-2A
PT1887	80	" " "	325	6.3V-1A Tap at 5V-2A; 6.3V-2A; 6.3V-CT-2A
PT1888	80	" " "	385	5V-2A; 6.3V-2A; 6.3V-CT-2A
PT1889	100	" " "	285	6.3V-1A Tap at 5V-2A; 6.3V-2A; 6.3V-CT-2A
PT1890	100	" " "	300	6.3V-1A Tap at 5V-2A; 6.3V-CT-2A; 6.3V-CT-2A
PT1891	100	" " "	325	6.3V-1A Tap at 5V-2A; 6.3V-2A; 6.3V-CT-2A
PT1892	100		385	5V-2A; 6.3V-2A; 6.3V-CT-2A

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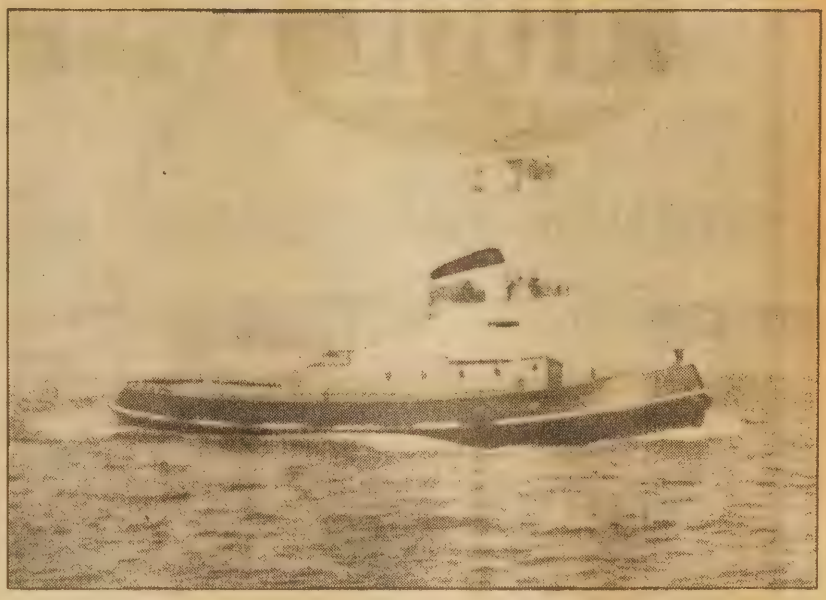
THE LEGACY OF RUDOLF DIESEL

THE MAN WHO REVOLUTIONISED BIG POWER PLANTS

The Centenary of Rudolf Diesel's birth has largely passed unnoticed. Yet so fundamental was his contribution to the technique of transport that his name has been generally adopted for the oil engine whose design he transformed. Diesels today are almost universally used in heavy transport, and diesel-electric locomotives are rapidly supplanting steam all over the world.

By WALTER MINCHINTON

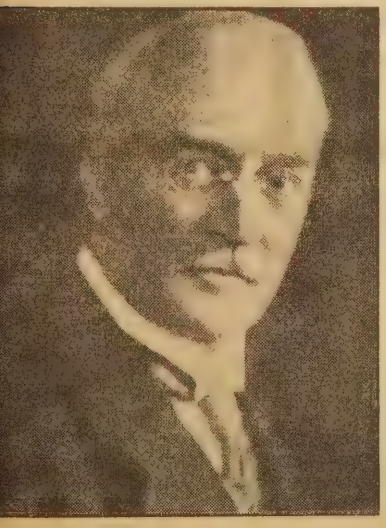


This modern tug operating on the Clyde, has a 2-stroke four cylinder diesel producing 750 b.h.p. at 320 r.p.m. Using a revolutionary propeller design it is remarkably manoeuvrable.

THERE was born in Paris on March 18, 1858, a child, Rudolf Diesel, whose name was to add a word to the language.

The son of a Bavarian leather-worker who had gone to France in search of work, he was forced to leave Paris with the family in 1870 when the Germans became unpopular there after the defeat of the French Army by the Prussians at Sedan.

Like many another exile, he was brought by his parents to London, where he first showed signs of interest in mechanical matters. As a result his parents were persuaded to send him back to Germany to be trained. He was educated first at Augsburg, there to make such an impression that his transfer to the technical High school at Munich was arranged.



Rudolf Diesel.

On the completion of his studies he returned to Paris as manager of a company which manufactured refrigerating equipment. The choice of job was to be of importance for the future.

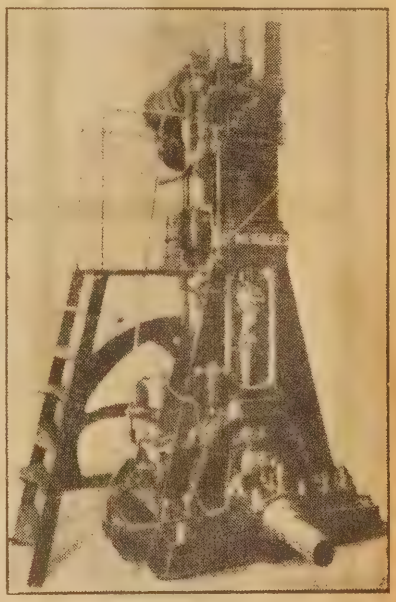
By the 1870s the steam engine had become the major source of power. The steam locomotive provided the chief means of transport, the steamship was rapidly ousting the sailing ship, and steam engines were generally accepted in manufacturing industry.

A BETTER ENGINE

Though to many people its position seemed impregnable, the more daring spirits were nevertheless struck by the low efficiency of the steam engine and efforts were being renewed to invent a better engine. The time was propitious for, with the development of the oil industry in the United States of America, an alternative source of fuel was to hand.

The "heroic" theory of invention—the idea that the creation of a new machine is the product of a single moment of inspiration like James Watt's conceiving the steam engine while watching a kettle—gives a misleading picture of the real process of invention.

In its place the social theory of invention has won more general favour. This view holds that any new invention is the culmination of the work of many men, each of whom makes a small but vital contribution to the translation of the original idea (which perhaps more than one of them had) into the practical machine capable of commercial development. Certainly of no invention can this have been more true than of the oil engine to which Diesel gave his name.



The Mirrlees diesel engine built in 1897 at Glasgow developed 20 b.h.p. at 200 r.p.m. It was in constant use until 1939.

While the petrol engine, in which the mixture of air and petrol is ignited by a spark, electrically provided by a sparking plug, was being developed and improved, there were attempts to use oil and to ignite it by compression. In England the firm of W. D. Priestman, of Hull, produced a paraffin engine in 1887,

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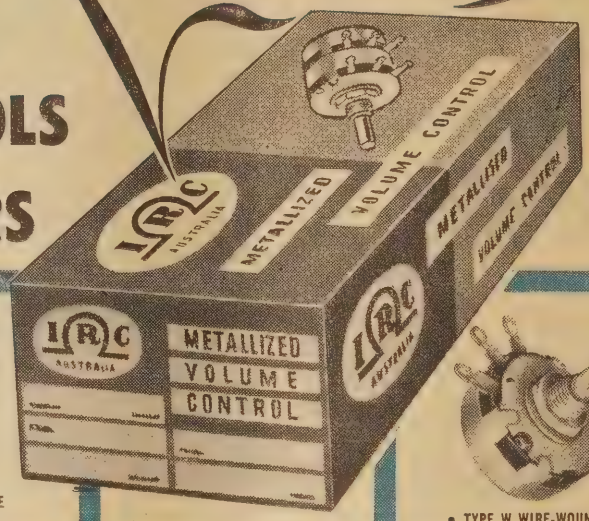

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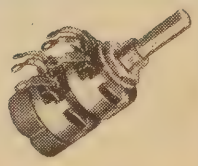
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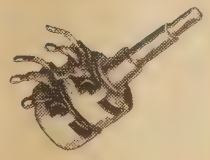
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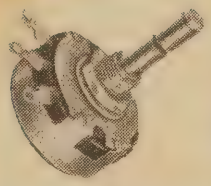
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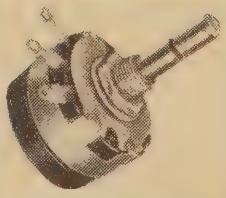
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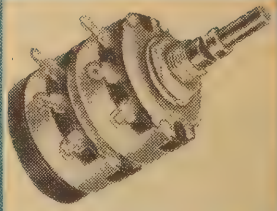
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based on a patent of two years earlier.

In this engine the oil was injected after the air in the cylinder was compressed, but the mixture was still ignited by a spark following petrol engine practice. Then, in 1890, Akroyd Stuart took out a patent which made significant contributions to the development of the oil engine. In this engine, the Hornsby-Akroyd built in 1892, the fuel was injected in "solid" form, was not mixed with air, and was ignited without a spark.

Amongst those in other countries seeking to develop this new form of power was Rudolf Diesel. From about 1880 he had been convinced that the steam engine would be superseded. His experience as a refrigeration engineer, through which he had learned a good deal of heat was given out, provided him with the vital clue.

HIGH COMPRESSION

It led him to experiment with an engine in which the air was so highly compressed that its temperature was raised high enough to ignite the oil when this was injected. Others had tried to develop engines with low compression; Diesel's contribution to the history of the oil engine was not to invent it, or make it work, but to introduce the principle of high compression. This brought with it consequent high efficiency—and considerable engineering problems, notably the need for sturdy cylinder construction to withstand the high pressures and for an efficient fuel injection system.

The original patent Diesel took out in 1892 proposed the use of powdered coal, but the first engine which was built in the following year used oil. Unfortunately it blew up, and it took another four years of perseverance before a workable engine was produced.

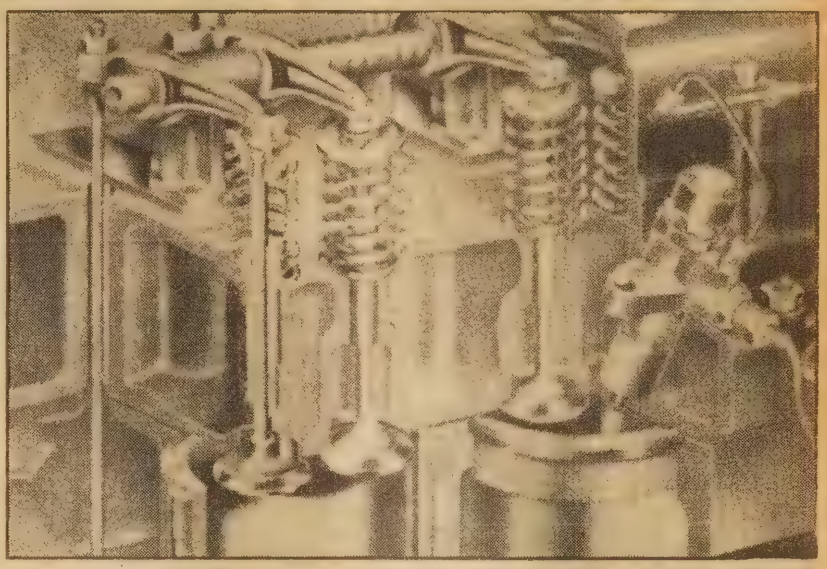
Once the prototype had proved that a combustion-ignition engine could work, the engine was quickly, one might say, too quickly, put into production not only in Germany but also in Great Britain and the United States. But operating difficulties led to a flood of criticism and some of the concerns with which Diesel was connected encountered financial trouble. Faced with such difficulties, Diesel became severely depressed; and on the night of September 29, 1913, he fell overboard from the Antwerp-Harwich mail steamer and was drowned.

Thus Rudolf Diesel died before the possibilities of his combustion-ignition engine were fully exploited. But he gave his name to this type of engine and the connection has remained for three principal reasons. Perusing the idea of creating such an engine with fanatical enthusiasm, he was a fervent propagandist in his own cause, giving many lectures on his ideas in his latter years.

PUBLISHED WORKS

Secondly, he embodied his ideas in two books, "The Theory and Construction of a Rational Heat Motor" (1893) and the "Genesis of Diesel Motors" (1913). And, thirdly, he was fortunate enough when he returned to Germany in 1890 to receive the unstinted backing of the Krupp and M.A.N. (Maschinenfabrik Augsburg-Nurnberg) companies without which his first attempt could never have been turned into the workable engine of 1897. Successful innovation depends not on employing inventors before they make inventions but on employing them afterwards. But there is a further reason why the term "Diesel engine" continues to be used. It is simply more descriptive than "oil engine" and less clumsy than "combustion-ignition engine."

CROSS SECTION OF DIESEL MOTOR



This drawing shows the arrangement of valves and fuel injection. There is no spark plug.

Though the earty diesel engines were slow-running, heavy and bulky, they were gradually adopted for various purposes because of their high efficiency and low fuel consumption. On land they were used as stationary engines, notably as pumping engines and for electricity generation, but it was for marine purposes that they made the greatest headway.

MARINE ENGINES

Most of the early vessels powered by diesels were small, such as tugs, yachts, canal boats, and the Polar vessel Fram. For naval purposes, diesel engines were of valuable assistance in the development of the submarine, where they provided power for surface use; as auxiliaries, they were installed in warships of the Dreadnought class.

But it was not until 1912 that the first marine diesel engine was installed in a big ship, the Selandia, built by Burmeister and Wain, of Copenhagen. So successful was it, however, that from that year onwards for speeds between 12 and 18 knots — in other words, for the typical cargo liner — the diesel engine was unchallenged for economy of propulsion.

While the variety of duties for which the combustion-ignition engine was employed on land and sea widened in the 1920s, its slow running and ponderous character seemed to rule it out of account wherever a light portable motor was required. Yet its clear advantages encouraged further engineering experiments. They resulted in the reduction of the powerweight ratio and the evolution of more compact and quicker-running engines, an advance which in turn made the employment of the diesel engine for road transport possible.

In 1931 the first London bus to use an oil engine was put on the road; in the following years the diesel engine swept the field for heavy road transport. Since 1945 further developments have taken place, necessitated often by the rising cost of petrol, and the invasion of the small vehicle range began. A number of London taxis are now so equipped and the versatile Land-Rover can be obtained with diesel engines. On the railways, diesel engines were used before 1930 mainly in shunting locomotives.

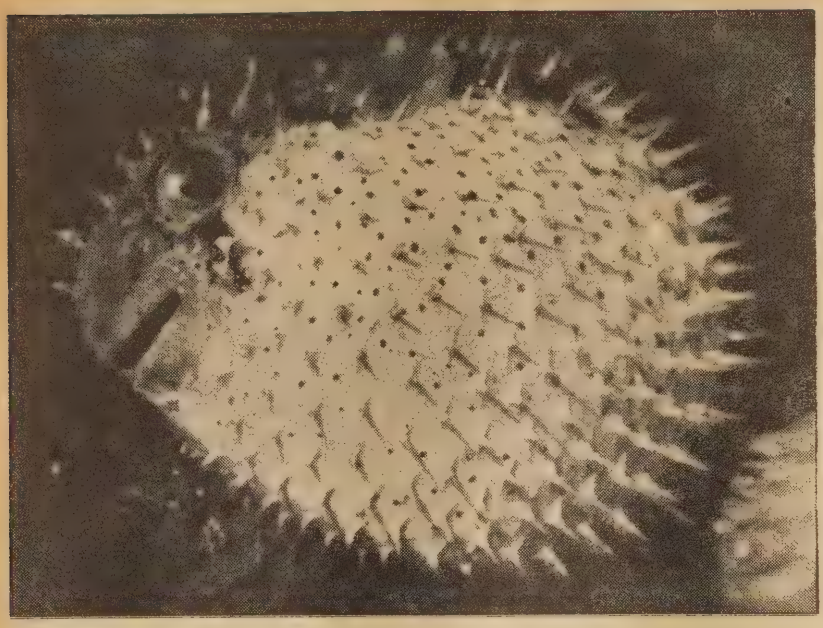
Then, in 1931, the first diesel rail-car service to operate in the British Isles opened in County Donegal. The development of hydraulic or electrical transmission systems enabled more powerful locomotives to be built. So rapid has been their adoption, particularly since 1940, that diesels now provide the major source of motive power on the railways of the world. Though the initial cost of the diesel locomotive is high, it has several advantages over the steam locomotive.

It is more efficient, more flexible, requires less maintenance and uses a fuel which is easy to store and handle. Consequently it can be used more intensively than the steam locomotive. The last steam locomotive was built in the U.S.A. in 1949, and the construction of such locomotives for British Railways ceased in 1956. At the present time British Railways have 50 large diesel locomotives, 800 smaller ones for shunting purposes, and 1,500 multiple-unit vehicles. The complete modernisation plan calls for a total of 4,600 diesel vehicles of various types.

FOR LARGE SHIPS

In sea transport, the most significant development has been the installation of diesel engines in large ships. In 1930 the White Star Line installed such motors to power their new liners, the Britannic and the Georgic, but the steam turbine continued to be used for large high-speed ships. During World War II, however, a growing number of warships were fitted with diesel engines; by 1945 their use was general among the navies of the world. More recently, turbo-charged engines, which use the exhaust gas to

(Continued on Page 83)



This foolish little fellow might have served for a Walt Disney model with his roguish glance and puffed-up body. He is a porcupine fish and well able to discourage unwanted visitors.

Fascinating Facts About the Fish Family

Facts about scales which scientists have revealed are almost as incredible as the tales told by keen fishermen of the "one that got away."

by Calvin Walters

FISH are such important factors in the economy of most countries that, whilst most people think about them mostly in terms of sport, scientists all over the world spend countless hours in studying the habits and behaviour of these submarine creatures.

To the average person fish might seem somewhat of a dull subject to write about. Most people would give merely a passing thought to the beauty of the various kinds of fish they see in private aquariums or in pictures relating to tropical islands and leave it at that.

There are many others to whom fish have a special appeal

There are those who spend their weekends sitting in a boat with baskets of tackle, a demijon full of orange juice and newspaper parcels of frightful looking and noisesome bait. These people are interested only in catching more fish than they can possibly use, returning home with one eye out for the fisheries inspector in case they are caught with the tiddlers, and the other eye out for some fellow who will listen to the tales of the big ones they couldn't land.

They spend endless hours at the local with outstretched arms and tongues and thoroughly enjoy themselves without any thought of the scientific aspects of their sport.

Then there are those who stand on the edge of the sea in the most dangerous places holding rods as large as telegraph poles. About 1 per cent of the time is spent in actual fishing. The remaining time is engaged in dodging big waves, replacing sinkers which have become fixed on the bottom of the sea, renewing hooks, recovering the bait which has been washed from the rocks, and untangling lines.

These fishermen also have long arms which have become stretched by constant exercises in indicating dimensions but are not interested in the scientific aspects of their sport.

There are many other grades between these and the professional fishermen who roam the seas in boats and who depend on fishing for their living.

The professional fisherman is scientifically minded to the extent that he will seek information from scientists regarding the feeding habits of fish so that he can have a rough idea of the possibilities of various rivers, lakes, ocean reefs and so on.

He is not interested as to whether a fish sleeps, or feels pain, why it is coloured or how it makes love. All he wants to know is what it eats, where it likes to swim, how deep it goes, how big it grows and what time of the day it is likely to get hungry.

ICHTHYOLOGISTS

To gain all this information there are fellows called Ichthyologists who spend their lives out at sea, in rivers, lakes, inland seas, deltas, under waterfalls and wallowing in billabongs and dams.

They gain information which is of great value to the professional and sporting fishermen alike. They determine the trout or salmon population of inland streams and build fish hatcheries. They collect fish eggs and scatter them from aeroplanes into rivers all for the benefit of the sporting fishermen.

Over the years these people have come to light with some curious facts about fish.

There is not space enough here to detail all the oddities regarding our finny friends so we will touch on two or three matters which are of peculiar interest.

Everyone knows that you can tell the age of a horse by his teeth, the age of a tree by counting the number of annular rings, the age of a blonde—well that's impossible. But everyone does not know that the age of most fish is revealed in their scales.

Before we go right into this startling revelation let us first have a look at a fish's outer covering.

First of all there is a skin. The peculiar thing about the fish's skin is that it is alive right to the outside.

This is quite the reverse to the skin of other creatures which live out of water. The outer layers of these creatures consists of dead cells. This is the case even in the human being. This is due to the fact that the living cells beneath must be protected from injury and so we are provided with several layers of hard, transparent dead cells which serve to render this protection.

Any land creature including man which has been burnt or which suffers an abrasion of the skin knows to its sorrow what it feels like to have the living cells exposed.

Another reason for this protection is that cells can only live in a liquid environment. The outer covering keeps the liquid inside.

The fish on the other hand lives in the liquid medium which he requires for his continued existence. He therefore exposes his living cells to this medium by having living cells right to the outer layers of skin.

There is a natural law however which makes it dangerous for a fish to have no protection for this outer living layer.

This law is called osmosis and behaves in this way. If two solutions of unequal strength are separated by a semi permeable membrane the weaker solution will pass through the membrane to the stronger solution. The skin of a fish is in the nature of a semi-permeable membrane.

Now the internal fluids of a fish are weaker in salt content than that of the surrounding water in the case of a salt water fish. If means were not provided to prevent it, the law of osmosis just described would cause the weaker solution of the fish to flow out into the more dense sea water and the fish would actually become dehydrated.

In the case of a fresh water fish his internal fluids are more salty than the surrounding water and osmosis would allow the weaker surrounding water to pass through the semipermeable skin membrane into the fish until it becomes water-logged, as it were.

SLIMY COATING

In order to protect themselves against the dire consequences of either condition of dehydration or waterlogging the fish secretes a slime from his skin cells and this covers his body with a protective coating.

Because of this protective slime coating the fish is also protected to a great extent against the inroads of parasites and bacteria which might otherwise gain entry into his internal economy.

So important is this slime coating to the safety of the fish that workers in aquariums and fisheries wear wet gloves when handling the fish.

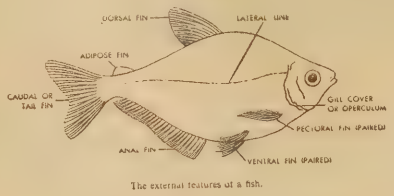
Dry hands or gloves would remove enough slime as to render the fish vulnerable to attack by diseases when it is reintroduced to the water.

So much then for the skin structure of a fish. We pass on to the very interesting feature of the scales.

The scales of a fish are composed of dead cells similar to that of the fingernails of human beings and the claws of animals and birds. They are created in all cases by living cells which secrete the material of which they are composed.

Not all fish have scales but most do, and it is due to the scales that fish present an endless variety of colour and pattern.

When a scaled fish is born it has no scales but in a very short time scales begin to grow.

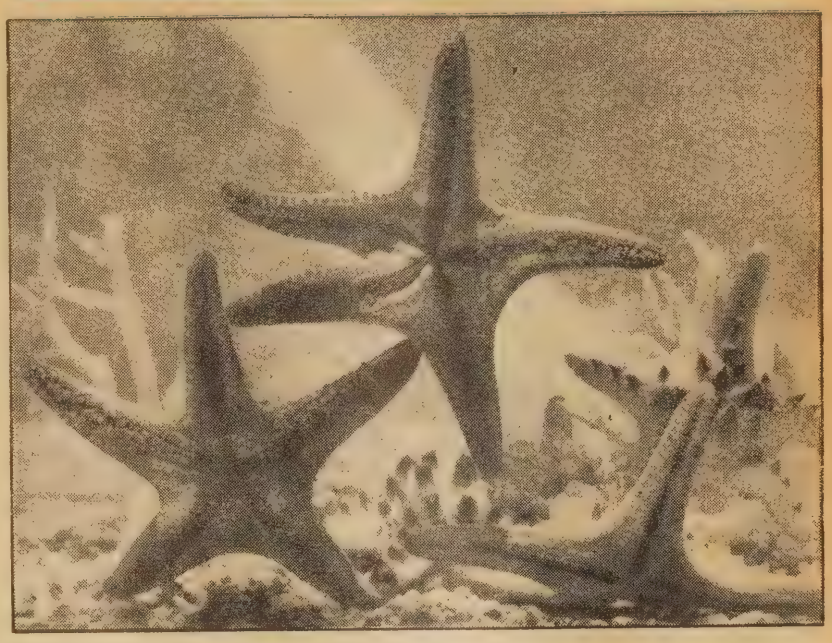


The external features of a fish.

External features of a fish.

This weird deep sea angler fish catches others by attracting them to a luminous bulb on the end of a long fishing rod, which it dangles in front of its mouth. This one, taken from the stomach of a sperm whale near Albany, was the first to be found in Australian waters. Less than 50 are known to science.

THE STAR FISH WERE NOT DANCING



Question—When is a fish not a fish? Walt. Disney again would make good use of these star-fish, apparently engaged in a lively dance. Actually they are climbing the glass wall of a tank.

This time period varies according to the species of fish. Some begin to grow scales when only about half an inch long. Others are up to two inches long before they decide to clothe themselves with this protective coat of mail.

Scales begin to grow from points under the skin called nuclei. They grow backward out of the skin until the forward end of one scale is more than covering the rear end of the next scale. The result is a complete covering over the fish, each scale overlapping the next like the tiles of a roof.

The number of scales which will cover the fish's body is established early in the piece and the number never varies despite the ultimate size of the fish.

Each scale is designed to cover a specific portion of the fish's body and it does so throughout the life of the fish. As the fish grows and therefore any portion of the body grows, the scale grows with it and it is only that portion of the body which is covered with its own individual scale.

THE SCALES

Scales are composed of two layers of material, the lower layer being a flexible interlacing fibrous mass and the upper layer a hard, brittle substance called clear dentine. By a peculiar process of growth the scale never grows in thickness but only in diameter.

As mentioned, each scale grows in area at the same speed as that portion of the fish which it covers.

This growth takes place by the addition of new rings of scale matter round the edge. Many of these rings are added annually just as a tree adds one ring annually and by which its age can be determined.

You cannot, however, tell the age of a fish by counting the number of these rings. This is done by noting the chang-

1ST.

1956

Thomas was the first Company to produce a 21-inch picture tube in Australia. It was a 90-degree aluminised tube with electrostatic focus, incorporating a "bent" gun and ion trap. Public acceptance of the larger picture soon established 21-inch tubes as the most preferred size in all makes of receivers.

1957

The first short-neck 90-degree tubes in this country were introduced by Thomas. These tubes feature a "straight" gun and the saving in length has enabled manufacturers to produce slimmer, more compact cabinets. This new design eliminates the need for ion traps and variable ion trap adjustments

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The most sensational advance in Australian television is another Thomas "first"—the flat-cushion, 110-degree picture tube, now being extensively used in super-slim television receivers.

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ing character of the growth of rings.

The process for this was devised by two persons named Johnston working in England and Dahl working in Norway and is as follows.

Scale growth is influenced by the conditions of food supply, temperature, light and spawning activity.

Thus in the summer time, food is plentiful and the temperature is ideal. The fish feeds well and grows rapidly.

During this rapid growth many rings are laid around the scale and wide bands are formed.

During the winter months food is not so plentiful and the lower temperaure makes the fish languid and without much appetite. During this period growth is retarded and only narrow bands of scale material are laid down.

GROWTH RINGS

Thus there is an alternating series of wide and narrow bands of growth rings and one wide band plus one narrow band represents one year's growth. These are called annual checks. Count the number of combinations of wide and narrow bands and you have the age of the fish.

When fish such as salmon migrate from fresh water to salt water the event is clearly marked in the scales.

This is due to the fact that food is comparatively scarce in the fresh water and when the fish migrates to salt water where food is more plentiful, it grows at a more rapid rate, and the width of the summer bands increases. Thus, the two different widths of the salt water summer band and the fresh water summer band show how many years the fish dwelt in each place.

The spawning seasons are also clearly marked on some fish scales like the trout and salmon. During the spawning season the fish not only ceases to grow, but it ceases to eat, with a result that it must live on its accumulated fats. A physiological process causes an absorption of the edge of the scale with a loss of up to eight rings.

When the spawned fish again begins to eat and grow, these ragged edges of the scales become filled with a clear material and the new growth rings are laid down around this. Thus, a permanent spawning mark is for ever embedded in the scale.

CALCULATING LENGTH

The length of a fish at any year of its life may be calculated from an examination of the scale. As the same factors which control body growth also control scale growth, it follows that there must be a ratio between the length of the scale at any given time and the length of the scale at some previous time.

Suppose we have a fish which is 12 inches long. The actual age does not matter for our purposes.

Let us require to find out how long the fish was at the end of its first year.

We first of all measure the distance from the middle of the scale to its edge. Say it measures a half inch. Now we measure from the same point (the middle) of the scale to the first annual check. Say it was one-eighth of an inch. An eighth of an inch is one-quarter of half an inch. Therefore, the length of the fish at the end of its first year must have been one-quarter of what it is now. One-quarter of 12 inches is three inches, which was the length at the end of the first year.

This method can only be used on scales from fish which have never spawned, because the damage done to the scale during the spawning season upsets the relationship between the two lengths scale, length and fish length.

Scales on a fish are only replaced when damaged. These replacements are easily seen on the body of the fish because they are devoid of annual checks. Seemingly the replacement scale grows with such extraordinary speed that there are no annual check rings as on a normal scale.

It will thus be seen that in the scale of a fish there is an almost complete history of its existence.

The ability to read the scales in this manner is one of the most important aspects of the work of those engaged in maintaining the supply of fish to an adequate level and to those professional fishermen who wish to make accurate forecasts of fishing prospects in future years.

In the former case it is important to determine the size of a fish when it spawns. Having determined this, laws are passed prohibiting the capture of fish below this size, so that it will have a chance of spawning once or twice before it is finally captured and falls into the frying pan.

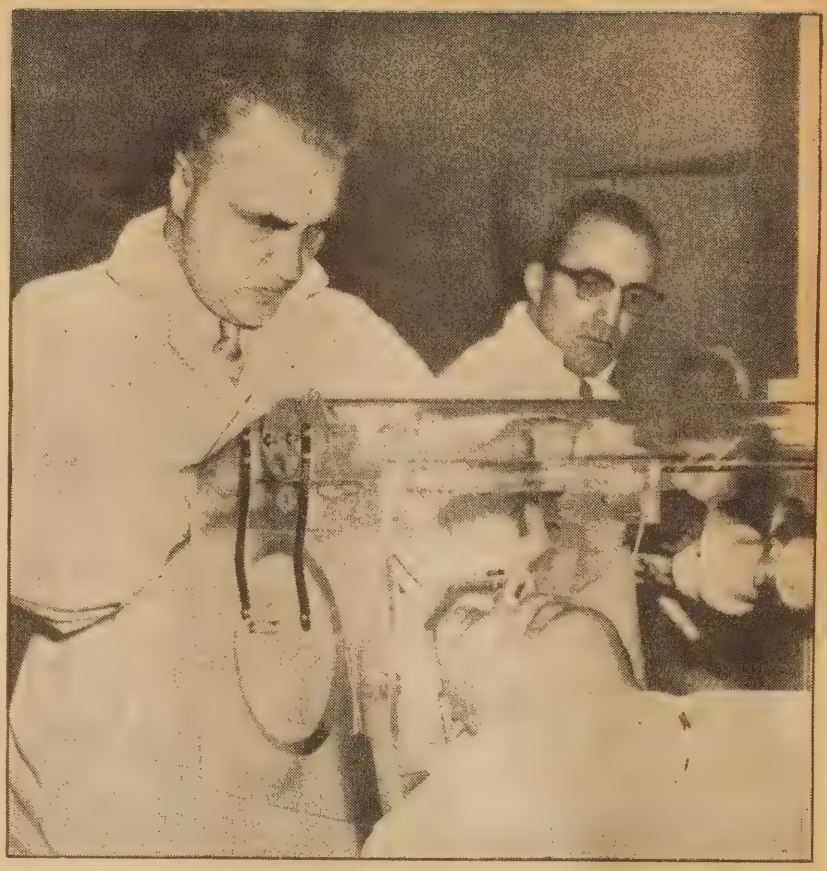
Examination of the scales is also necessary for the fisheries worker to determine whether sufficient food is available for fish in artificial environment.

In the case of forecasting the prospects for future years of fishing, it is necessary to take samples of a particular species of fish—say, herring—from known fishing grounds. Because of more successful spawning years previously, it may be found that a certain age class of fish will be more abundant. Thus by an analysis of the population by means of their scales, fishermen are able to predict the extent of the main shoals of fish in future years.

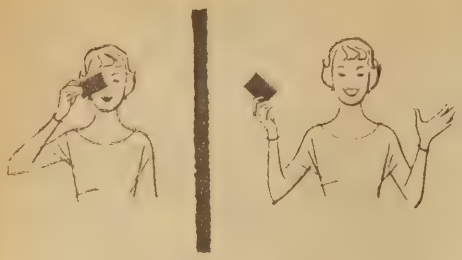
Another interesting point about fish scales is that not only the number but

(Continued on Page 105)

BRAIN OPERATION BY PROTON BEAM



A team of five Swedish and one Scottish doctor performed a brain operation in which there is no knife and no anaesthetic at the Gustaf Werner Institute for Nuclear Chemistry last December. The patient suffered from acute pain and depression, and is than half a cubic centimetre of tissue in an insensitive portion of the brain had to be destroyed. Forty radiations from a proton beam, directed at different angles by rotating the operating bottle, were made, and the patient was conscious all the time. The theatre is 65ft below the ground, and during each radiation a team of doctors sat watching the patient on a TV set. The synchro-cylotron which produced the proton beam was built by the Institute. Our picture shows two doctors operating the machine.



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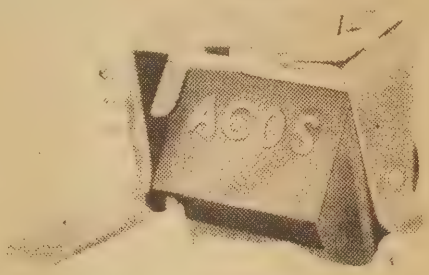

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GP 73-1B	"	2 sapphire styli	5 15 0
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GP 73-1B	"	2 diamond styli	15 19 6
GP 73-1C	"	2 sapphire styli	5 15 0
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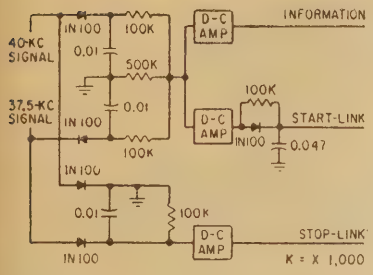
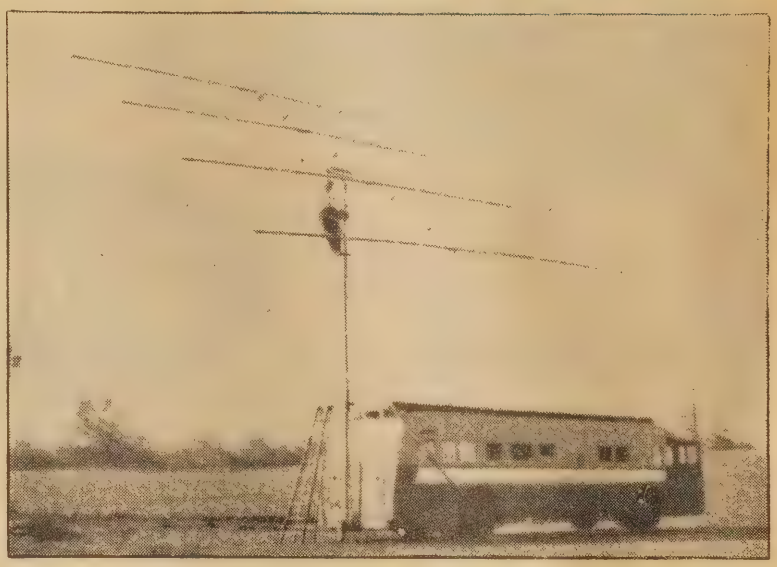


Fig. 3 — Simplified schematic of burst detector. The start-link channel indicates when the incoming signal exceeds a usable threshold.



Equipment to study meteor auroral reflections was constructed by Stanford Research Institute for Rome Development Centre, Griffiss Air Force Base, Rome, New York.

METEOR BURSTS PROVIDE COMMUNICATION PATH

Meteoric-scatter propagation system synchronises transmission of radio waves with ionised trails of meteor particles. Meteor bursts reflect transmitted signals and convey intelligence in vhf band for transmitter-receiver distances up to 1,500 miles. High-speed, intermittent transmission may use recorded voice, stored pulse or facsimile information. Advantages wide bandwidth, low power, information security and compact antennas. —Electronics

PROPAGATION of radio signals by reflection from ionised meteor trails, as shown by experimental meteor-burst systems, such as the Janet system pioneered by the Canadians, and the circuits discussed in this article show that a reliable, low-capacity communications channel can be established for distances up to 1,500 miles.

Meteor-burst communications permit the use of low-power transmitters and low-gain antennas. Usable frequencies up to 100Mc are far higher than can be normally propagated by the ionosphere. The VHF band is not affected as severely by ionospheric disturbances as are H-F circuits.

An experimental meteoric-scatter propagation link, established between Montana State College in Bozeman, Montana, and Stanford Research Institute in Palo Alto, California (830 miles apart), has been in almost daily use since October, 1956. Excellent teleprinter performance is now obtained, and no propagation failures have been encountered for over 18 months.

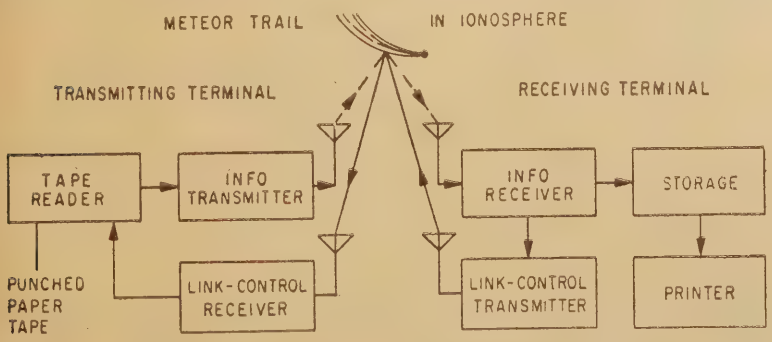


FIG. 1 — Overall block diagram of meteor-burst communications system shows signal path for the detection and control of transmission, as radio waves bounce from ionized meteor trail. Information is transmitted only during meteor-burst.

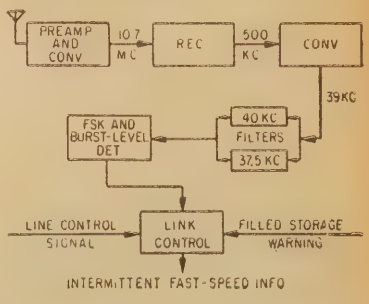
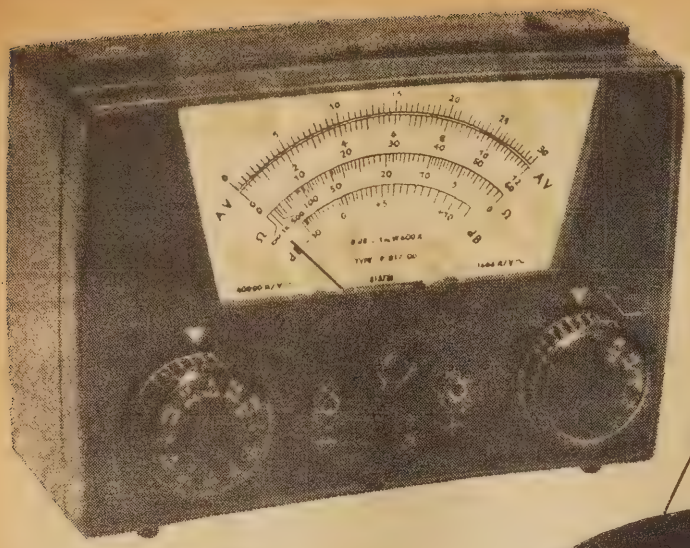


FIG. 2 — Information receiver detects the presence of a usable signal during a meteor burst and demodulates the fsk signal information.



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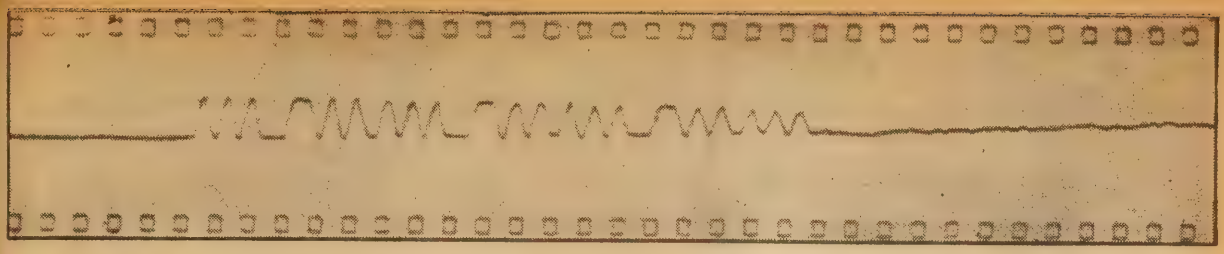

Oscilloscope photo of filtered and detected signal from an actual meteor burst.

A block diagram of the meteor-burst link is shown in Fig. 1.

Teleprinter information is transmitted from Bozeman on 40Mc. while link-control information is transmitted back from Palo Alto simultaneously on 32.8Mc. The intermittent meteor-burst channel is utilised effectively only when an acceptable signal is picked up at the receiver.

Detection and control of transmitted information takes place in three steps. First, the information transmitter at Bozeman radiates its 40Mc CW recognition signal. A sensitive receiver at Palo Alto monitors this frequency. During a meteor burst, the receiver detects the presence of a usable signal and modulates the link-control transmitter on 32.8Mc.

TELEPRINTERS USED

Finally, the Bozeman receiver demodulates the link-control signal from Palo Alto, and uses it to start and stop the teleprinter modulation of the Bozeman transmitter.

Conventional teleprinter is used. Each character is represented by a start pulse, five information pulses, and a stop pulse transmitted sequentially. Conventional FSK modulation with a frequency deviation of 2.5Kc is used for both information transmitter and link-control transmitter. Laboratory constructed 2Kw transmitters are used at each terminal installation.

The power amplifier is a conventional class-C push-pull amplifier using a pair of 4-400A tetrodes.

During bursts, information is transmitted from Bozeman at 10 times the normal 60 w.p.m. rate.

Simple three-element Yagi antenna arrays are used at both terminals. Transmitting and receiving antennas are spaced at about 200ft apart in a line perpendicular to their line of directivity. This space reduces transmitter coupling into the receiver so that simultaneous transmissions and reception take place without the need of filters in the antenna feed line.

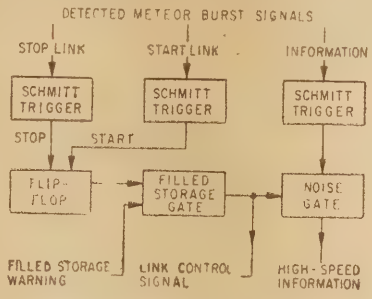

FIG. 5 — Link-control block diagram. Start and stop links are regenerated by Schmitt trigger circuits.

Receivers at both terminals are similar with the exception that the information receiver at Palo Alto also detects the received signal strength in addition to demodulating the FSK information.

A block diagram of the information receiver is shown in Fig. 2. A cascade preamplifier with a 2db noise figure is followed by frequency conversion to 10.7Mc. A Collins 5LJ receiver used as an IF stage is followed by another conversion to 40Kc. Filters separate mark and space frequencies and detectors and control units follow.

Two separate and independent types of teletypewriter storage and speed converters are used at the receiving terminal. One type uses a continuous loop of magnetic tape as the recording medium, while the other uses magnetic cores.

Storage components are interchangeable and the only input required for each is the detected intermittent teletypewriter signal from the receiver. Storage outputs drive conventional 60mA line current communications teleprinters.

BURST DETECTORS

The dual-purpose detector of the information receiver first decides when a usable signal is received from the transmitting station. This rapid decision uses minimum meteor-burst time. The receiver is quick to detect the end of a burst to halt information before the signal fades below the usable level. Transmitted information is detected with minimum signal-to-noise ratio making full use of all available transmission time.

A simplified schematic of the detector is shown in Fig. 3. Outputs of the two mark space filters are rectified and DC outputs are added both destructively (plus to minus) and constructively (plus to minus). The destructive added DC output is connected to two channels. The start-link channel indicates when the incoming signal exceeds a useable threshold. The other channel supplies the fsk information.

Transmission is continuous between bursts on one of the two signal frequencies. When the signal reaches the receiving terminal at Palo Alto with sufficient strength so that the output of one filter exceeds the output of the other filter by a pre-set level, a signal in the link-control circuits shifts the frequency of the link-control transmitter.

This method of starting the link discriminates against coherent interference in both filters. The start-link signal is also filtered with a special diode circuit after detection.

Thus, the probability of starting the link on large impulse noise signals is decreased. The additional filtering causes a loss of about 10 milliseconds of transmission time.

Once information transmission starts, the destructively added DC output follows the fsk signal by reversing polarity. Detected pulses are regenerated by a Schmitt trigger in the link controls and sent to the storage system. This infor-

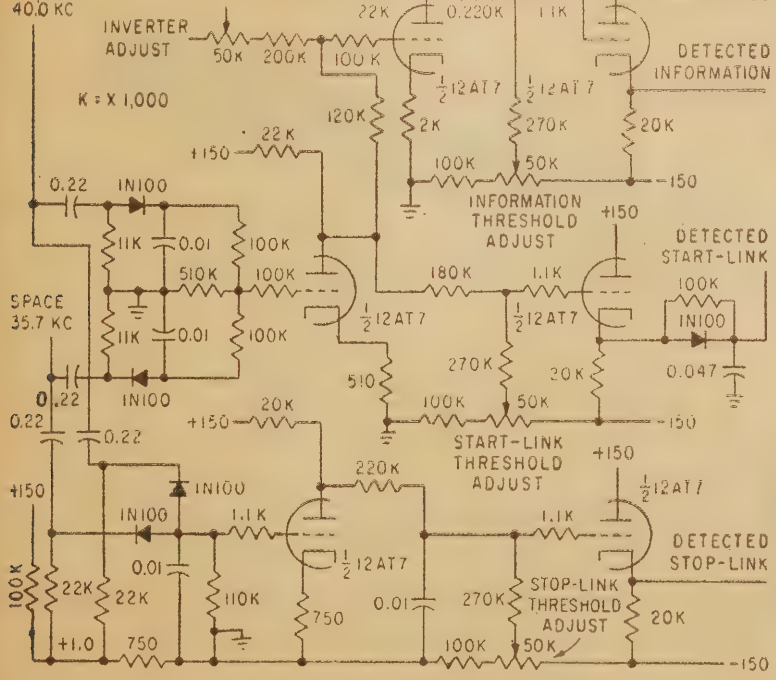

FIG. 4 — Detector circuitry. Rapid response start-stop signals use minimum burst time.

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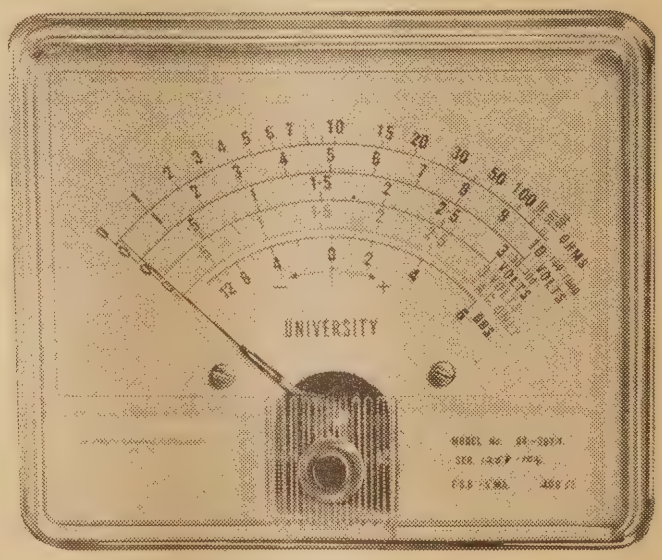
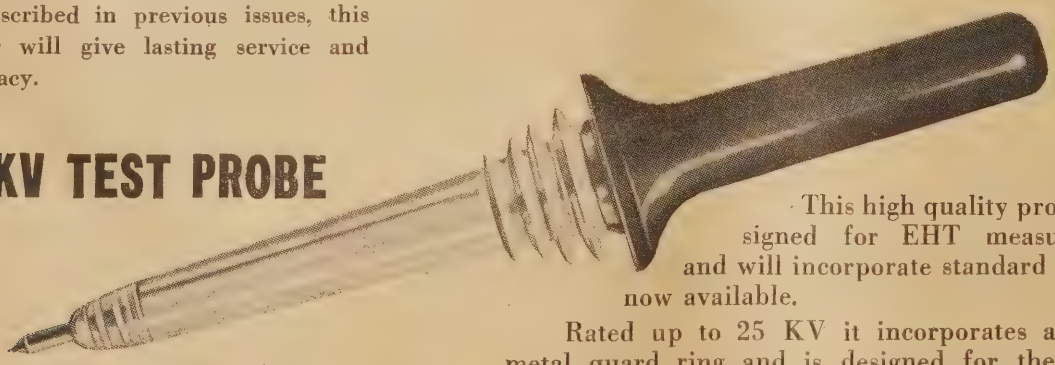


30KV TEST PROBE



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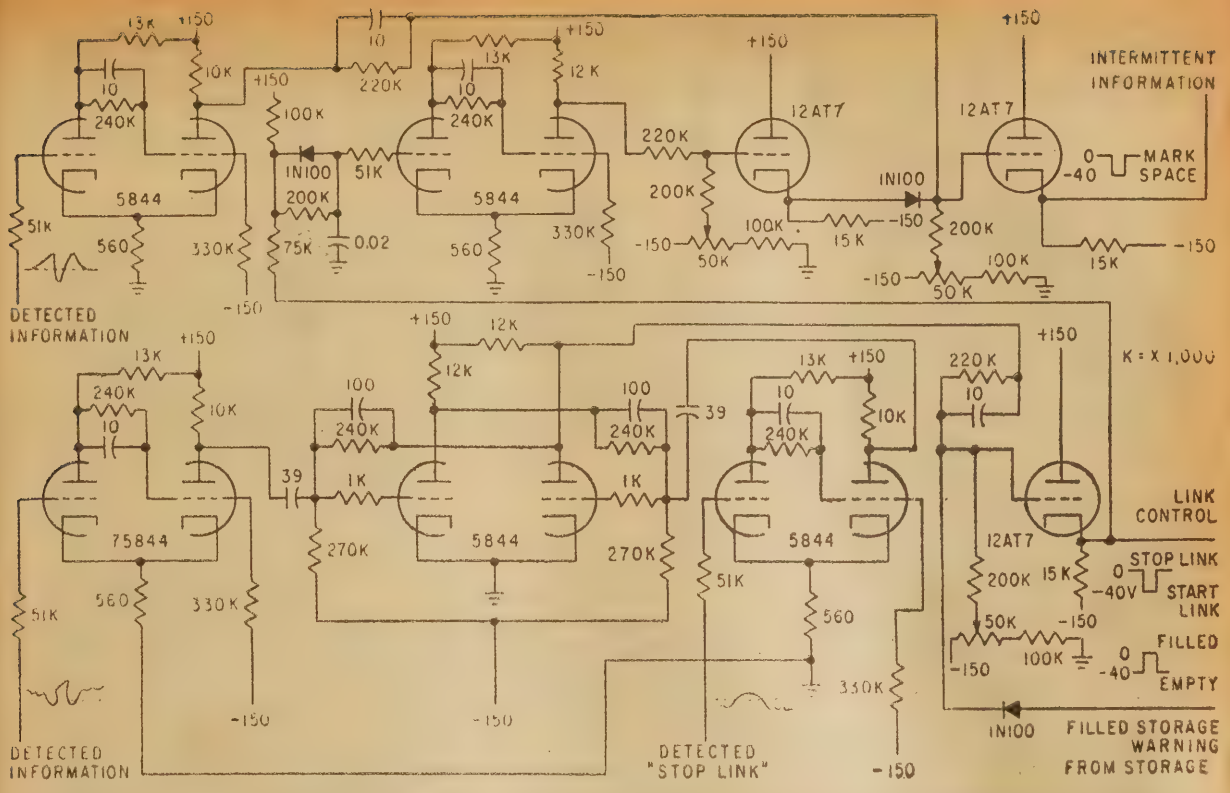

FIG. 6 — Link-control schematic. Triggers are set well above ambient noise to preclude false triggering by noise spikes.

mation is the desired intelligence.

The constructively added detector output measures the signal level during fsk As the received signal is always in one filter or the other, detector output is independent of the received information and is a function only of the received signal strength. This signal indicates when the meteor-burst signal fades below the stop-link threshold. Little post-detector filtering is done on the stop-link signal to permit rapid response to fast-fading meteor signals.

A circuit diagram of the detector circuits is shown in Fig. 4.

Signals from the link-control circuits modulate the link-control transmitter and supply regenerate information signals used by the storage devices.

A block diagram of the link-control circuits is shown in Fig. 5. Start-link and stop-link signals are regenerated by Schmitt triggers with separately adjusted thresholds. The start-link threshold is about 6 v. As an increasing start-link signal goes through 6 v, a pulse sets a flip-flop. The flip-flop output switches the link-control transmitter to the start-link frequency. Additional start-link signals caused by the frequency shift keying have no effect on the flip-flop

THRESHOLD SETTING

The stop-link trigger threshold is adjusted to about 5 v. As the signal fades below this level a pulse, generated by the Schmitt trigger, sends the flip-flop back to the stop-link frequency. When the storage capacity is approached a filled-storage warning signal overrides the flip-flop output through the filled storage gate, and the link-control transmitter is immediately switched to the stop-link frequency.

The threshold of the fsk information signal Schmitt trigger is adjusted to 0 v so that pulses are regenerated on the basis of polarity only and not amplitude.

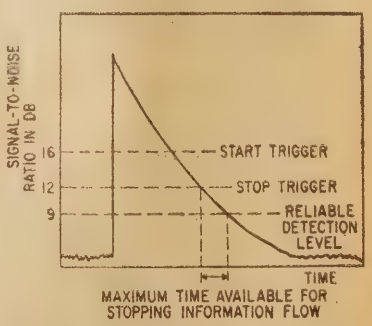

FIG. 7 — Threshold levels of stop-link trigger are based on known maximum fade rate of meteor burst.

In the absence of a received signal, noise coming through the filters would trigger the circuit in a random manner. To prevent this noise from producing an output the regenerated signal passes through the noise gate, which is opened and closed by the link-control signal. This insures that there will be no information output until the received signal exceeds the start-link threshold, at which point the received signal is large enough to control triggering of its regenerator

The noise gate is closed by the stop link signal, but only after a time longer than the inherent delay between the stop-link signal and the arrival of the last information pulse at the receiver This delay is a combination of the two path-transient times, the response time of the link-control receiver and the time for the transmitter to finish sending the last character This total delay was found to be about 30 milliseconds maximum.

The link-control circuit is shown in

(Continued on Page 83)

ABOUT METEOR-BURST COMMUNICATIONS

OUR earth, travelling in its orbit around the sun, sweeps up millions of meteors each day, ranging from dust sized particles to large bodies weighing many tons. Although few large meteors are intercepted by the earth's upper atmosphere showers of meteor particles enter the E-region of the ionosphere Meteoric collisions with the sparse upper-atmosphere atoms, 30 to 50 miles above the earth cause the meteors to become white hot and leave trails of ionised meteoric and upper-atmosphere particles. Ionisation density of these particles is sufficient to reflect incident vhf radio waves.

Received signals from meteor bursts vary in duration from a few milli-seconds up to many seconds. Spacing between signal bursts varies from a fraction of a second to minutes. The number of signals received vary with the time of day. The maximum number of signals occur in the early morning and the minimum in the evening Although the signals are erratic in duration spacing and amplitude a dependable communications path is statistically available.

Recent propagation studies together with the general advancement in communication knowledge, show that an intermittent system that transmits information only during the brief intervals in which a useable reflected system is received has many advantages.

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NEWS AND VIEWS OF THE MONTH

Our bulgy earth

DATA received from the American Vanguard satellite had shown that earth was slightly pear-shaped, according to American scientists.

National Aeronautics and Space Administration said Earth was "a bit bulgy in the south and pointed in the north."

They said Vanguard had enabled scientists to draw an accurate new picture of earth because the satellite travelled in a "very precise, trustworthy orbit."

There were little wobbles in Earth's flight—caused by variations in its shape.

Earth has been pictured previously as nearly a sphere with a bulge around the equator.

The scientists said Vanguard data had established that the sea level was 50 feet higher and 50 feet lower at the northern and southern Polar caps respectively than had been thought.

Vanguard's orbit was so reliable that the satellite was being used even more efficiently than stars for navigational fixes, they said

Moon not cold

SCIENTISTS now say there is pretty good evidence that the moon may not be cold beneath its surface.

Last November a Russian scientist claimed to have witnessed a volcanic eruption of luminous gas on the moon.

Data gathered on November 3 has since been analysed and is believed to confirm the report.

D. Niikolai A. Kozyrev, of the Crimean Astrophysical Observatory, has written a detailed report on his findings for "Sky and Telescope," an astronomical magazine published at Harvard University.

The article was translated by Dr Luigi Jacchia, of Harvard.

The Russian discovery, he says, has exciting possibilities for man's exploration of space.

Voyagers to the moon might be able to find heat and a source of power by burrowing down beneath the surface.

Extensive borings might produce enough heat from the interior to operate generators and recharge equipment.

Man-made sun

A RUSSIAN scientist, Professor Georgi Babat, believes that in about 40 years a man-made sun will shine on Moscow.

Professor Babat is a specialist in high frequency currents.

He said the new sun would shine from a height of 12 to 18 miles.

Mirrors of four high-frequency stations would reflect upwards electro-magnetic rays.

The rays would intersect above Moscow and white-hot nitrogen and oxygen molecules would shine.

Professor Babat also said high-frequency transport whose electric engines would need no surface contact would be in wide use in 15 to 20 years.

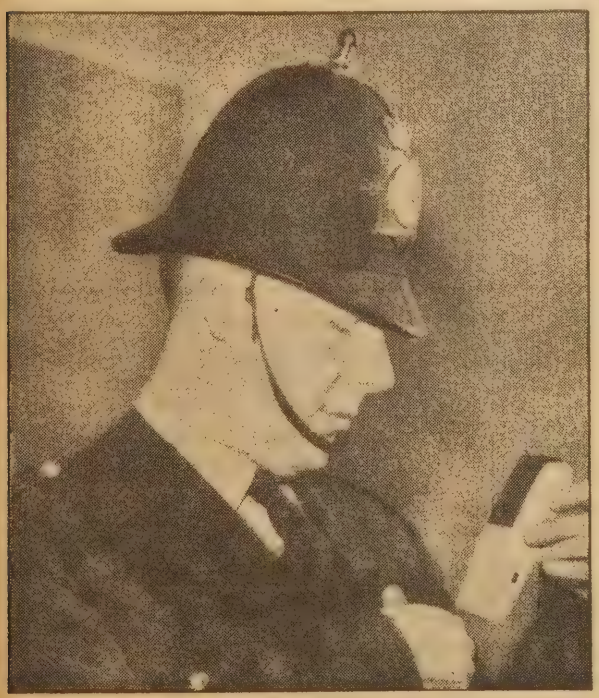
Fast atomic subs

ATOMIC submarine ocean liners—with speeds of 60 miles an hour—are visualised by the navigator of the Nautilus.

Lieutenant Shepherd Jenks, who charted the Nautilus' historic voyage under the Polar ice pack and across the North Pole, forecast rapid commercial passenger and cargo shipping under the sea.

"It is entirely feasible that commercial use will be made of the atomic submarine in the future," he said at a Press conference.

He said atomic submarine ocean liners could travel from Japan to England in six days and cross the Atlantic in 72 hours.



☆

Small listening receivers which call the user when a given code is transmitted continue to be developed. This miniature receiver is being tested by the Nottingham City Police to keep touch with men on the beat. It could have been the downfall of Robin Hood!

☆

TV tracks crooks

THERE is a new eye cocked on the international crook, an eye which follows him all over Europe, and which eventually will be tailing him over most of the globe.

Interpol's TV circuit is literally "the eye that never sleeps." All of Europe's capitals are being hooked into a closed-circuit TV dragnet.

Interpol, the "International Criminal Police Organisation," has become famous since the last war for its dogged international stalking of big-time criminals.

It has become the world's most glamorous police organisation, largely because no other police outfit can duplicate its resources.

Interpol's TV dragnet is the best example. In the case of the jewel thief, TV screens at police headquarters in capitals all over Europe flash the suspect's photograph and fingerprints.

With these, Interpol officers, speaking in German, French Italian, English, Spanish and Dutch, provide additional details.

At Wiesbaden, headquarters of West Germany's Federal Criminal Police, authorities say police television looms as the most important crime-detection device since fingerprinting.

"Television is literally the all-seeing, ever-present eye," a German Interpol official explained.

"We can, if necessary, place TV cameras at frontier points, at railway stations and at airports."

Facts about the B.B.C.

EVERY year the B.B.C. publishes a handbook which provides concise information about its day-to-day task of world-wide broadcasting. The B.B.C. Handbook, covering the year ended March 31, 1958, has recently been published, and a few facts selected from it are given below:

The B.B.C. broadcast over 20,000 program hours in its sound services and nearly 3,000 hours in its television service in Britain. External broadcasting amounted to over 29,500 hours.

The Overseas Services, directed outside Europe, broadcast in English and twenty-four other languages.

The B.B.C. General Overseas Service broadcasts for over twenty-two hours a day and has a world-wide audience.

The General Overseas Service news bulletin at 1800 hours G.M.T., is rebroadcast every day in some twenty countries.

More than fifty countries regularly rebroadcast B.B.C. overseas programs.

The Transcription Service supplied over 700 sound radio programs to broadcasting organisations overseas, and English by radio distributed English lessons with explanations in over thirty lan-

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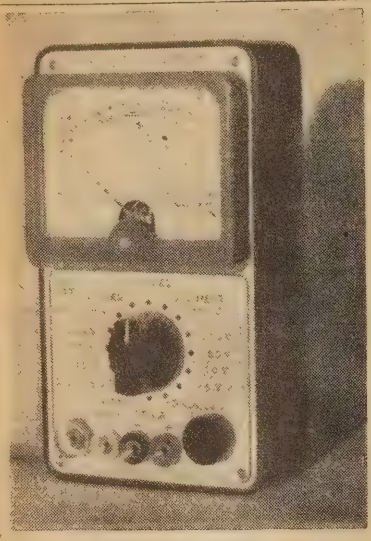


TESTER BOY MULTIMETER

The Tester Boy Multimeter is ideal as a portable instrument for the hobbyist motor mechanic, etc. Dimensions are 6in high, 2 3/8in wide, and 3 5/8in deep.
Weight 11lb 13oz.
Ranges as follows:—
Volts AC and DC 2.5, 10, 50, 250 500, 5,000.
Resistance 0-10,000 ohms, 0-100,000 ohms and -1 meg. ohms|
Decibels minus 2db to plus 10db. Odb to plus 22db. By referring to a chart up to plus 56db may be measured.
The case is black bakelite with a metal panel and 3in meter. Test leads are provided and also a leather carrying case. Sensitivity of meter is 1,000 ohms per volt.

Price of this unit is £7/10/-

SPECIALS

1. **PM 957 Ferrocart Vibrators,** 12-volt synchronous, split reed with octal base. Socket connection diagrams available. Price only 10/- each.
2. **Germanium Diodes,** English make, brand new and perfect Ideal for use as crystal detectors, rectifiers, etc., in radio and TV sets. Price only 3/11 each.
3. **Philips Transistors,** available in the following types:

OC44	£1 18 0
OC45	£1 16 7
OC71	£1 7 1
OC72	£1 13 3
2OC72	£3 6 6

4. **Ferroxcube Rod Aerials with Coil.** Ideal for portables, mantel sets, etc. Equal to 60ft. outside Aerial. Price only 16/6 each.
5. **Magnetic Pick-ups.** English make, with bakelite arm for 78 r.p.m. records. Light weight Price only 7/6 each.
6. **Gramo Pick-ups.** Excellent quality, turnover head crystal type, with two Sapphire stylus. Worth £5/15/- Our Price, £2/15/-.
7. **I.F. Transformers.** Standard size slug tuned 455KC, guaranteed. Only 10/- each.
8. **2-Gang Standard Condensers,** suit Broadcast Band. Only 12/6 each.
9. **100 Ohms 25-watt Rheostat,** wire wound on mica former, with porcelain insulation. Only 4/6 each.
10. **250 Ohms 25-watt Rheostat,** as above. 4/6 each.

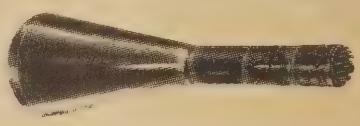
CONDENSERS

Brand new condensers are available ex-Disposals, Army and Navy equipment, etc.

Capacity	Voltage
3PF	2000 Wkg
00017mfd	4000 "
00017mfd.	1500 "
0002 mfd.	600 "
0003 mfd.	2500 "
005 mfd	750 "
01 mfd.	600 "
01 + .005 + .001	2000 "
01 + .01	2000 "
015	300 "
02	1000 "
02	2000 "
025	400 "
.05 + 05	500 "
.1	1500 "
.1	4000 Test
.1 + .1 + .01	2250 Test
.1 + .1	1500 Test
.1 + .1 + .1	600 Wkg
.25	400 "
.25	400 "
.25	1500 Test
.25	600 Wkg.
.25	5000 Wkg
.25	200 "
.5	400 "
.5	750 "
.5	500 "
1 mfd.	400 "
2 mfd.	400 "
3 + 5	350 PV
4	400 Wkg
5	40 PV
10	

Type of Condenser	Price
Bead type Ceramic	9d
Block Mica	2/
Block Mica	3/
Mica	2/6
Block Paper	1/
Block Paper	2/
Block Mica	1/
Block Paper	1/6
Block Paper	3/
Block Mica	2/9
Block Paper	9d
Block Mica	2/
Block Mica	3/
Block Paper	1/6
Block Paper	1/3
Block Paper	2/3
Block Paper	3/
Interference Suppression suitable 240 Volts AC	2/9
Block Paper	1/
Block Paper	1/9
Tubular Metal Clad	1/
Tubular Paper	6d
Block Paper	9d
Tubular Paper	9d
Block paper	3/6
Tubular Paper	9d
Metal Clad, Tubular	1/3
Block Paper	2/
Block Paper	2/6
Block Paper	2/9
Block Paper	3/9
Tubular Electrolytic	1/3
Block Paper	4/
Tubular Electrolytic	9d

CATHODE RAY TUBES AND RADIO VALVES



Cathode Ray Tubes and Radio Valves. All brand new and Boxed. **Type VCR 138** 3½in diameter cathode ray tube. Ideal for oscilloscopes, etc. Characteristics: Filament Volts 4. Filament Current 1 amp. Anode 2-200 volts Grid 1-50 volts X Plate sensitivity .14. Y Plate sensitivity .33. Anode 3 — 1200 volts Electro-static deflection, Colour Green Socket connections can be supplied to each purchaser. **Price 25/. Type 815 Push Pull RF Beam Power Amplifier.** Used as class AB2 A.F. Power Amplifier and modulator. Max. output 75 watts. Class C Telegraphy max. output 75 volts. Class C Telephony max. output 60 volts. Filaments volts 12.6 or 6.3. An excellent valve for H.F. work. Brand new and boxed. **Our price 35/ each. Type EL50 Power Output Pentode** 6.3 volts filament with P type base 2 of these valves in Class B will give 80 watts output This is also an excellent single end tube which will give in Class A about 8 watts output and high gain Well worth 30/. **Our price only 7/6. 954 Detector Amplifier Pentode** 6.3 volts filament for UHF. **Price only 5/ ea.** We have stocks of some types of valves as listed These are all new and guaranteed

Valve	Price	Valve	Price	Valve	Price
1S5	8/6	58	7/6	2A3	12/6
26	5/	71A	5/	VT75A	3/6
27	5/	77	5/	6R7	7/6
31	5/	84-6Z4	7/6	6R7G	6/6
32	5/	85	5/	KDD1	5/
33	5/	506	5/	866A	19/6
34	5/	A109	5/	VR502	3/9
36	5/	A442	5/	1D5PG	5/
37	5/	A642	5/	1F5G	7/6
38	6/	ABC1	7/6	FC13	9/
39/44	5/	B409	5/	PM254	5/
45	8/6	B605	5/	PM1	5/
46	5/-	CF1 (SP13	7/6	PM12A	5/
49	5/-	VR91	5/	NR74	7/
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VR54	5/-			FC2A	5/
7C7	9/£			KC3	7/6

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guages, including Chinese and Portuguese versions of English lessons already published in French, German, Italian, Spanish, Dutch, and Swedish.

Developments in international television and the use of the Eurovision Link used over 200 films and more than 500 telerecordings. The B.B.C. receives 200,000 letters a year from listeners and viewers and has been broadcasting to countries overseas for 26 years.

Water-cooled cables

POWER is being supplied to the energising coils of Glasgow University's 450 MeV synchrotron by a new type of cable, capable of dissipating large amounts of heat from a confined space. The conductor takes the form of a hollow tube of copper: Terylene is used for insulation. Water flowing through the cable has the effect of allowing it to carry at least twice the current that could be passed without the artificial cooling of the copper. By lowering the temperature of the metal and hence its resistance the actual efficiency of transmission also appears to be increased somewhat.

The cooling water is either run to waste or recirculated, through heat exchangers—though in the latter case it would first have to be purified. The cable, which withstood prolonged tests at pressures of 70lb per sq. in., did not fail when subjected to pressures as high as 200lb per sq. in. for short periods.

Non-magnetic alloy

IF part of an instrument for measuring magnetic fields has to be made from non-magnetic materials, this usually means that ferromagnetic materials such as iron, cobalt and nickel must be excluded and some other material such as copper or aluminium is used instead.

For very delicate work, however, the natural magnetic properties of all materials may be a nuisance. Although they may be extremely weak magnetically they may, nevertheless, confuse the measurement of small magnetic fields.

Some materials (copper is one) are diamagnetic: that is to say, they are repelled instead of attracted by a magnet. By mixing copper with nickel (a strongly magnetic material), E. W. Pugh, working at the Carnegie Institute of Technology, has produced an alloy which is completely non-magnetic at ordinary temperatures, and even down to within a couple of degrees of absolute zero its diamagnetism is very feeble.

The composition of the alloy is 963 parts of copper to 37 parts of nickel.

H-bomb camera

FOR studying the growth of the fireball during the first few millionths of a second of a nuclear explosion, the Atomic Weapons Research Establishment has developed a number of very high speed cameras. One of them, the C5 camera, takes pictures at a speed of 10 million frames a second for 50 frames; each frame is 6 millimetres in diameter, with a resolution of 28 lines per millimetre.

The camera contains a mirror rotated at 400,000 r.p.m. by a compressed air turbine. It reflects the light through a number of "framing lenses," arranged in an arc, which focus the image on to a succession of places on a circular film track. To achieve an exposure time of only a 30th of a millionth of a second, A.W.R.E. uses a Kerr cell in the shutter.

BOOKS RADIO — TV ELECTRONICS

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ELECTRONIC PUZZLES and GAMES — by Matthew Mandl. (Recently reviewed in R, TV and H.) A number of puzzles and games, requiring only a few shillings worth of equipment. 128 pages of photos and drawings. . . . . Price 20/3.
RADIO-CONTROL HANDBOOK — Howard McEntee's famous book in its latest printing. A practical handbook on model plane, train and boat control by radio. Covers receivers, transmitters, motors, etc. 192 pages, packed with information. . . . . Price 23/3.
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TV FAULT FINDING. A handsome book, copiously illustrated and most authoritative. The book includes 112 circuits, drawings and photos (showing faults as they appear on an actual screen). **Price 7/6.**

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OUR CATALOGUE. We announced this somewhat prematurely some months ago. Our technical Staff are still reading through piles of books to see whether or not they are suitable for release. (We want you to order again and again, and do not want to sell books which will disappoint our clients.)

COMING—Late March . . . The 1959 Edition of THE RADIO AMATEUR'S HANDBOOK. Order now to save disappointment!! PRICE £2/14/-.

ELECTRONICS PUBLICATIONS (Australia)

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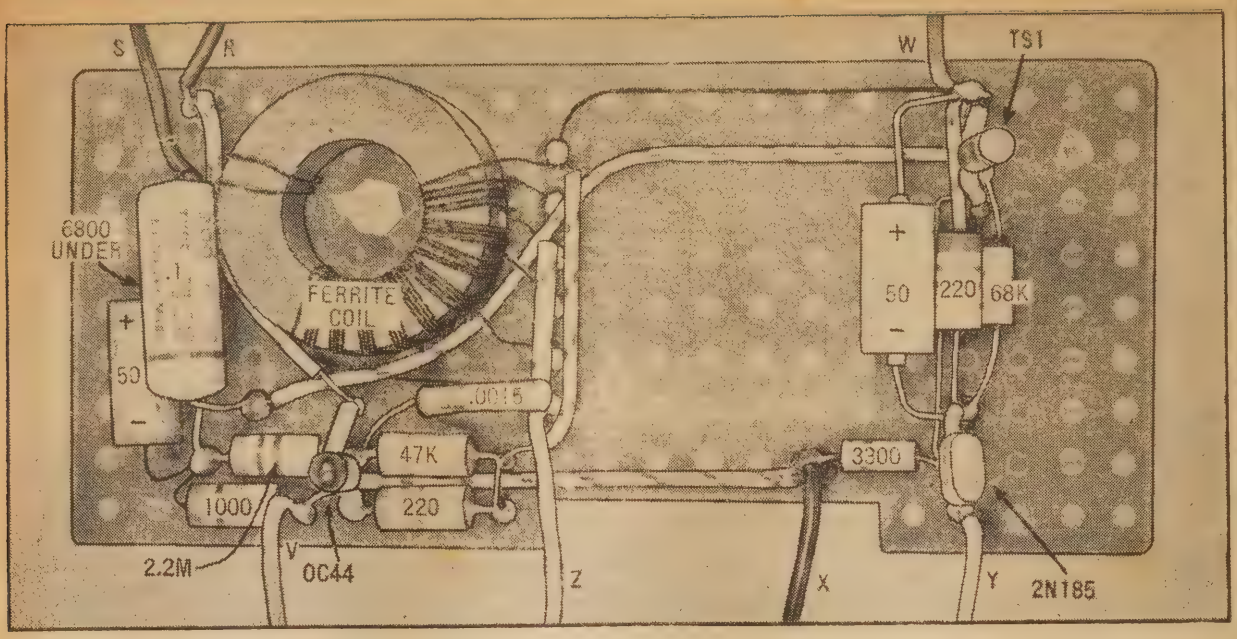


Most of the small components, wiring and transistors are attached to this piece of bakelite wiring board. A code indicates the connections to the metal bracket. Bakelite piece which clamps ferrite ring has been removed so that the coil can be seen.

A Three Transistor Mantel Receiver

A compact design using three transistors, our latest transistor receiver is self contained except for the aerial. It operates a built-in loudspeaker and gives enough volume for close listening. A simplified audio amplifier circuit saves 6 components making the set both easy to build and inexpensive.

by Maurice Findlay

JUDGING from comments we have received from various radio parts suppliers, lots of small transistor receivers have already been constructed, many to the single transistor receiver design appearing in the December issue and to the two transistor circuit which was published in the January issue.

The first of these circuits was intended mainly for reception of local stations although a selection of stations from a long distance, and even interstate, could be heard. As with any set, much depends on the type of aerial you have, the location and the time of day.

Extra volume and greater range could be expected from the set using two transistors which appeared in the January issue. As explained in the article, extra audio gain makes it practical to couple the aerial less tightly for a given volume and, therefore, the ability of the receiver to separate stations is improved.

No matter how close the station or how long the aerial, there is not much point in connecting a loudspeaker to either of these receivers because the small transistors are not capable of delivering sufficient power to move the cone by a worthwhile amount.

Having made the one transistor and, perhaps, the two transistor receiver successfully, experimenters are usually keen to try making a larger set capable of operating a speaker. It would be possible, of course, to make other additions to the set to improve its ability to pick up distant stations and also its ability to separate stations close together in frequency. Somehow, this doesn't have the appeal of a set which can give speaker volume on the local stations.

We will do some work on transistor sets with better sensitivity and selectivity in the future but for the moment we will concentrate on the simpler job of adding an extra audio stage.

Assuming that an extra stage gives enough amplification, the next thing to consider is just how much power is needed. This is difficult to define in exact terms. For example, if you propose to install a sound system in a hall, the power required could vary from 5 to 50 watts, depending on the efficiency of the loudspeakers, the sound-absorbing characteristics of the inside surfaces of the hall and the volume of sound required among other things.

A portable radio is not required to produce a very high volume of sound because it is usually operated close to the listener's ear. Valve type portables which have been used for a number of years, deliver, on the average, about 200 milliwatts maximum to the speaker voice coil. Full-sized transistor portables of the type we have described and which are available commercially, often do somewhat better and are able to deliver about 300 mW to the speaker.

Such transistor portables employ a pair of relatively small transistors in the output stage, but operate them in class B in order to obtain high-power output without exceeding the maximum allowable dissipation. Class B operation for low distortion audio requires that a pair of transistors be connected in push-pull.

In addition to the output matching transformer, a class B amplifier normally requires a driver transformer.

For a basic audio amplifier using class B, therefore, three transistors and two transformers are required. If you propose building a full-sized portable receiver, this is no objection, and the reserve of power output for portable use will be found very useful.

However, for the benefit of readers who would like a simpler set, or perhaps do not have too much money to spend, it is worth considering what can be done with a simple class A amplifier employing one transistor in the output stage and, say, one other transistor as a low-level amplifier.

A check with the manufacturers' data suggests that power outputs of somewhere about 40 milliwatts can be obtained in class A from one of the readily available audio power transistors such as the 2N185 and the OC72.

POWER OUTPUT

It is easy enough to set up instruments in the laboratory to feed 20, 30 or 40 mW into a speaker in order to observe just how loud a single tone of this power sounds. We were sufficiently encouraged by the original tests to design and construct a simple single transistor amplifier and attach it to the small two-transistor receiver described in the January issue.

Although the volume of the set was not sufficient for it to be likely to annoy the people in a downstairs flat, it could be heard quite well all over a normal living room and had volume to spare for listening within a few feet, as would mostly be the case with a personal or bedside radio.

This original set was constructed with a full complement of stabilising, coupling and bypass components making the circuit perhaps a little formidable for the near beginner.

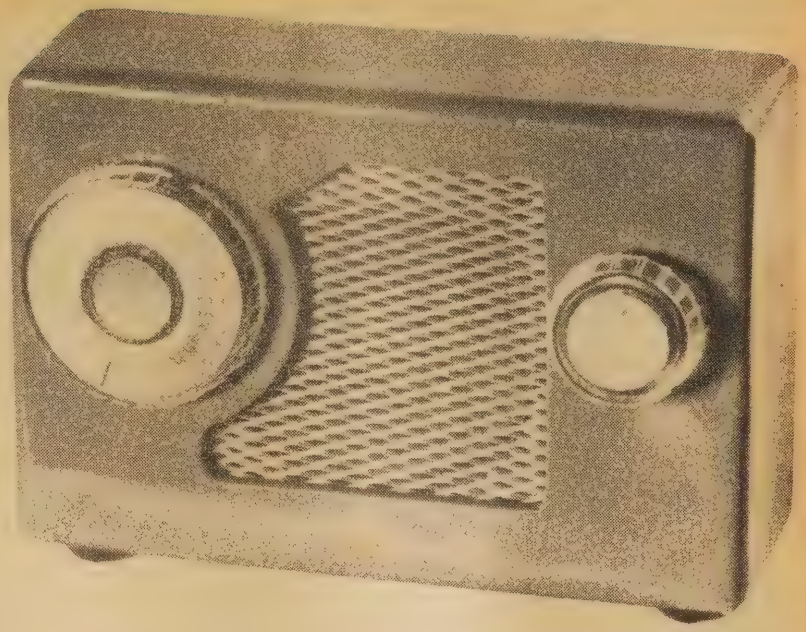
We then set out to see what could be done to reduce the number of parts, and finally came up with a circuit which gives satisfactory results and saves a total of six components.

The main disadvantage of the simplified circuit is that it gives lower power output at higher temperatures. If, for example, you take the set to the beach and stand it in the hot sun for an hour or so it will not deliver the same power as in the home at normal temperatures. At the same time, it will have to be much hotter than normal before the power output is so low that the set cannot be usefully enjoyed.

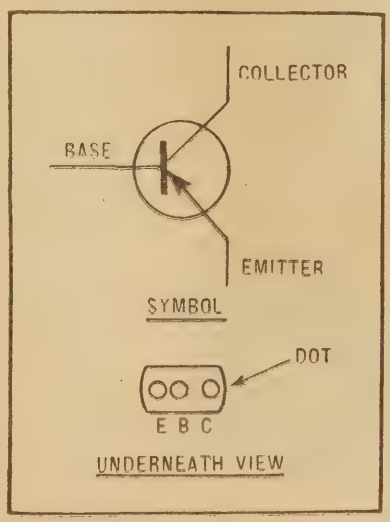
EFFECTS OF TEMPERATURE

When the set is exposed to higher temperatures the current, and power dissipation, of the output transistor actually decrease. The driver transistor is fully protected because of the load resistor in the collector circuit so that no damage will be done even if the set does happen to temporarily go out of operation due to high temperatures.

Considering the saving in cost of components and the simplicity of the wiring, we consider that the abbreviated circuit is well justified. The number of times it will fail to operate because of temperature will be few (if it ever does fail) and it is not like radio equipment installed in an airliner or some other essential service where a failure is likely to have grave results.



Full dimensions of this neat cabinet are given in the detailed drawing later in the article. Knobs suitable for both tuning and reaction controls are available from radio supply houses.



You will be able to identify the connections to all transistors mentioned in the article from this diagram

As part of our normal routine in designing the circuitry we have extracted figures of the power output at various likely temperatures and the range of power outputs with transistors throughout the tolerance range. However, this information is not as likely to be of much assistance as the more general information already given.

TRANSISTOR TYPES

Types OC72 and 2N291 may be used instead of the 2N185 without circuit change. A heat sink is desirable with the OC72, worthwhile with the 2N185 but unnecessary with the 2N291.

An OC70 may be substituted for the TS1 provided the bias resistor (68,000 ohms on circuit) is increased to 82,000 ohms.

So much for the audio amplifier.

The detector circuit is the same as used in both the single transistor receiver described in the December issue, and the two transistor receiver descri[illegible]

PARTS LIST

Cabinet and metal bracket (see drawings this article).
415 pF tuning capacitor.
30 pF trimmer capacitor.
10,000 ohm carbon pot. with switch.
4in speaker
Output transformer, 375 ohms to speaker voice coil.
Tuning knob (2½in diam.) and 1in diam. knob.
Ferrite ring (Ducon F4021).
26 B. and S. enam. wire
Nuts and bolts.
Hookup wire.
Eyelets.
No. 2364 battery.
3-pin battery plug for above.

TRANSISTORS

1 OC44, 1 TS1, 1 2N185.

CAPACITORS

2 50 uF 12VW electro.
1 0.1 uF 100V paper.
2 1,500 pF ceramic.

RESISTORS (all ½ watt)

1 2.2 meg.
1 68K.
1 47K.
1 6,800 ohm.
1 3,300 ohm.
1 1000 ohm.
2 220 ohm.

Reduce projector lamp failures with

STC BRIMISTORS

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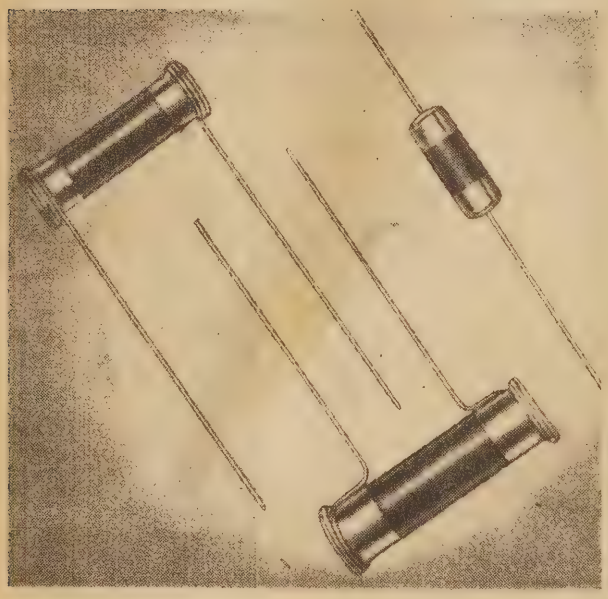
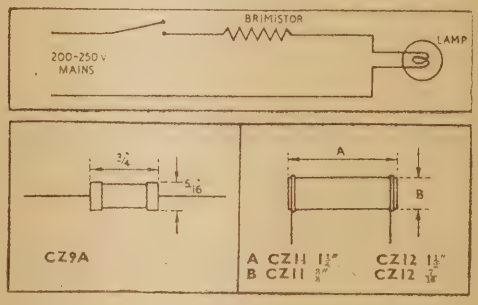


TYPES AND RATINGS					
Brimistor Type.	Maximum Continuous Running Current.	*Lamp Wattage.	Resistance at 20° C.	Resistance at Maximum Current	Retail Price.
CZ9A	1.0A	150 W.	350	3.7	2/11
CZ11	1.5	250 W. or 300 W.	140	2.5	5/3
CZ12	2.5	500 W.	120	1.5	6/8

* These figures apply to lamps operated on the 200 to 250 volts supp however, Brimistors may be used at lower voltages if the maximum co tinuous current is not exceeded. For example, the CZ11 could be us with a 110-volt 150-watt lamp.

EASILY FITTED TO ANY TYPE OF PROJECTO



GENERAL INFORMATION

The resistance of a projector lamp filament increases many times with temperature. Thus at the instant of switching on, when its filament is cold, its resistance is low and a very high surge current will flow for a fraction of a second. To avoid this undesirable surge, a Brimistor should be fitted in series with the projector lamp. Brimistors have a large negative temperature coefficient, so that their resistance falls as they warm up. Thus at switch-on, the current through the projector lamp is limited by the cold Brimistor. As the Brimistor warms up its resistance rapidly falls so that after a short time the full supply voltage is applied to the lamp, giving good suppression with the minimum of delay.

OPERATING NOTES.—At the maximum current rating, the body tempe ture of a Brimistor may reach 250 deg. C. Thus care must be taken mounting to avoid damage to adjacent components.

Since Brimistors operate by self-heating, it is important to ensure that t are not cooled by the fan when one is fitted to the projector.

At least ½in lead should be left free when connecting into circuit. Brim tors are made of a rather brittle material and will fracture if dropped subjected to severe mechanical shocks; they should, therefore, be hand with care.

After switching off, ten minutes must be allowed for the Brimistor to c down before switching on again if good surge suppression is required. H ever, if you do switch on again almost at once, you are doing no wo than you would without a Brimistor.

Brimistors must not be operated in parallel.

STC

K107

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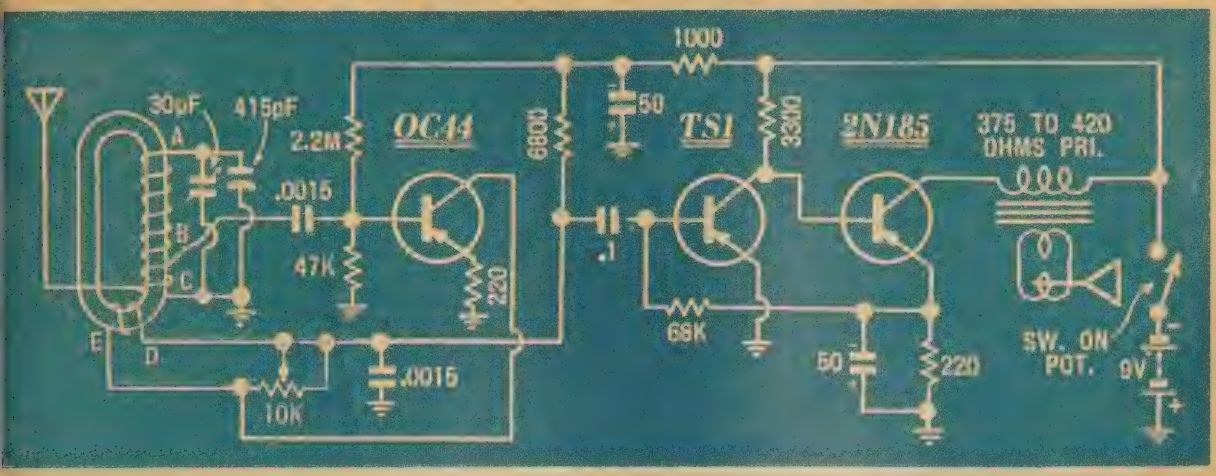
THREE TRANSISTOR CIRCUIT OPERATES SPEAKER



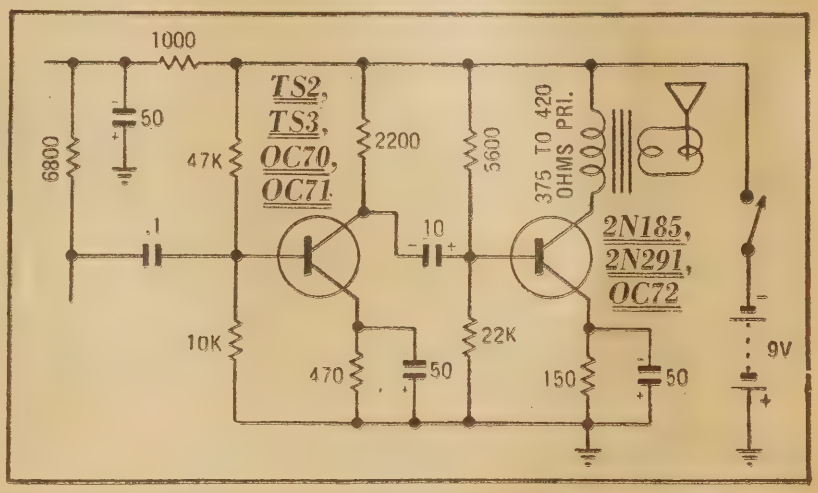
Circuit combines our tried and tested regenerative detector with a new simplified audio amplifier. Alternative transistors are discussed in the text. A heat sink is an advantage with the output transistor. Audio coupling capacitor (0.1 uF) is chosen to give response best suited to the small speaker and modest power output.

in the January issue. The coil wound on the ferrite ring has proved to be highly efficient and makes possible an outstanding performance in a regenerative receiver.

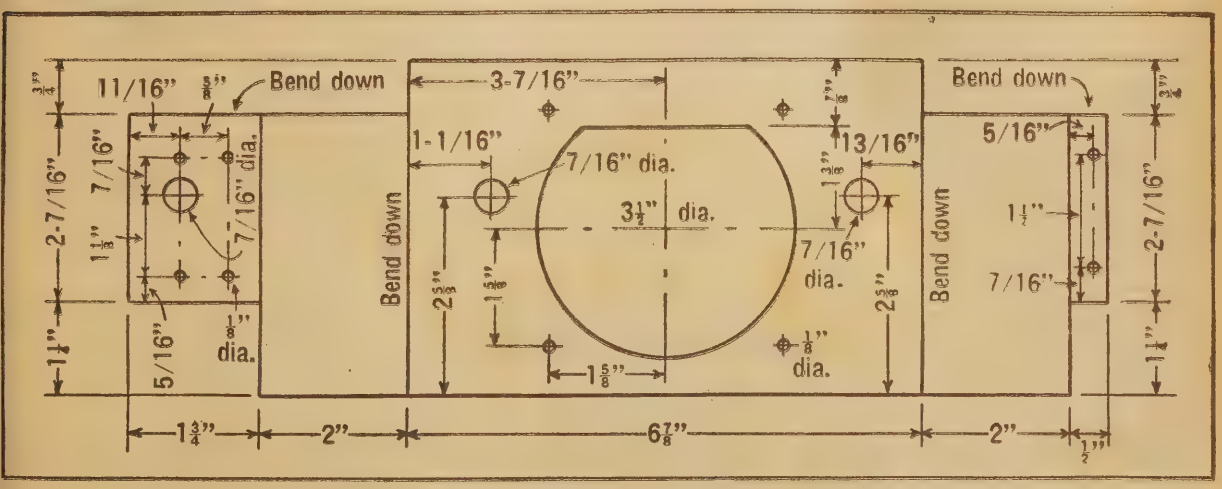
A 2N252 will often work well as a detector but may require a lower value bias resistor (2.2 meg on circuit). Values from 1.2 meg down to 220,000 ohms may be tried, the optimum depending on the individual transistor. Also, up to five turns on the reaction winding may be necessary.

COMPONENT MOUNTING

The job of assembling the components and making the set work is so simple that you should not have too much difficulty even if it is your first set. We have designed a special metal bracket to hold the loudspeaker, potentiometer and tuning capacitor. This bracket also support a wiring panel which bolts across the back, making a neat, compact assembly. The battery fits within the assembly, making the overall dimensions 7in by 4½in by 2 1-8in. The dimensions of the finished receiver depend on the thickness of the material used for the cabinet but, assuming or-



We recommend this circuit if you wish to use a transistor other than the TS1 or OC70 for the intermediate stage.



You can prepare your own metalwork from this drawing or order a ready-made bracket through a radio store.

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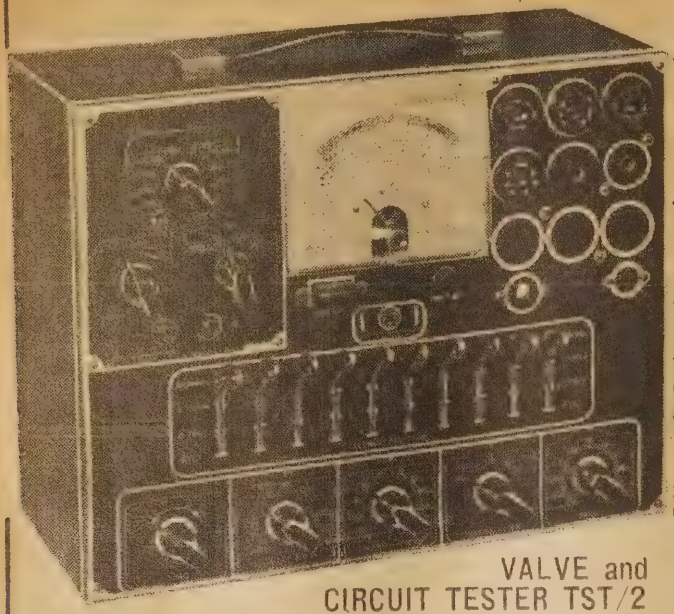
TEST EQUIPMENT
FAMOUS FOR FLEXIBLE FINANCE



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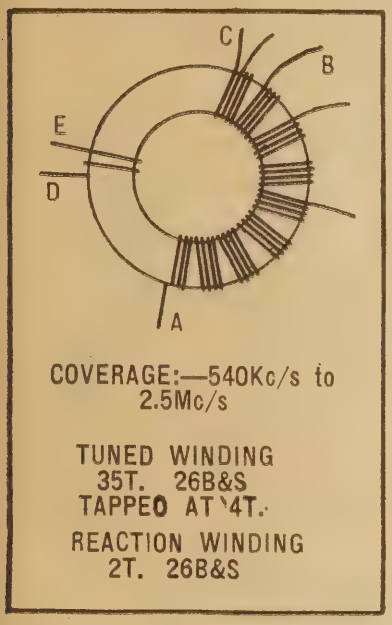
dinary plywood, need only be a little larger.

Assembly could be started by mounting the speaker, tuning capacitor and potentiometer. It may be found easiest to attach the extension spindle to the pot, shaft and mount it before the speaker.

Dimensions of the wiring panel are 5 3-8in by 2 3-8in in order that the speaker transformer will not interfere with its placement. A cut-out 1¾in by ¾in is required on one of the 5 3-8in edges. It should be 1¼in from one end.

ASSEMBLY

Components on the wiring panel should be mounted in accordance with the coded photograph. Eyelets are used as termination points. There is a total of seven wires running from the wiring panel to the components on the mounting plate. One is the earth return, one goes to the fixed plates of the tuning capacitor, one to the switch on the potentiometer, two to the speaker transformer, and two to the potentiometer. These should be left long enough for the wiring panel to be folded back so that checks can be made on all components and wiring without disconnecting anything. Two wires go from the switch on the potentiometer to the battery plug.



Details of the ferrite coil. Coverage, with trimmer, is approx. 540 to 1600 Kc.

Although these need only be about three inches long when the battery is in its normal position, we suggest that you make them about a foot long for ease of handling when the set is out of the cabinet.

Transistors should be soldered into circuit after all other components and we recommend that the connecting leads be left full length just in case you decide to use them in another set later on. The long lead length helps to reduce the thermal shock to the transistor element when soldering, although a wise precaution in any case is to grip the leads with a pair of long nose pliers between the transistor element and the point of soldering.

After rechecking the wiring and paying particular attention to battery polarity, transistor connections and the like, the power plug may be inserted in the battery, an aerial connected and the switch turned on.

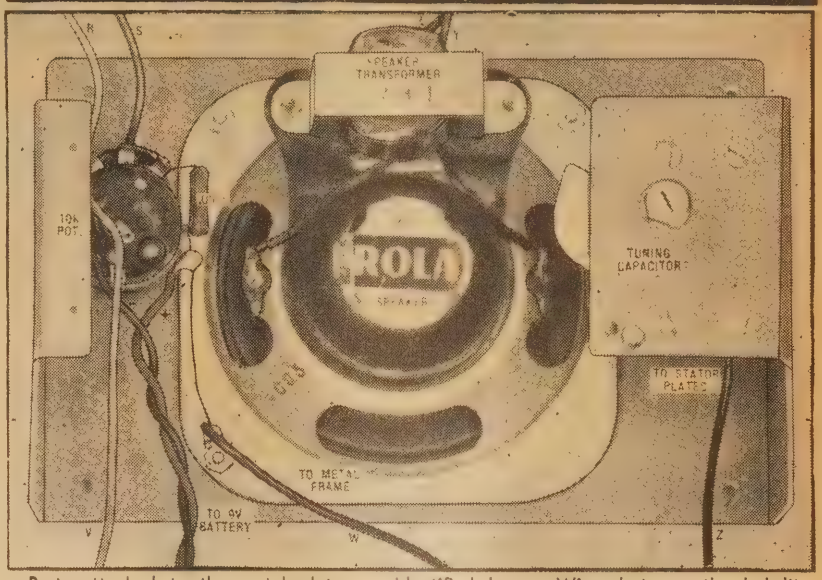
As the regeneration control is advanced, a point should be reached where there is a substantial increase in background noise, often described as a rushing sound. This indicates that the detector stage is oscillating.

With the detector in the oscillatory condition, stations will be heard as a whistle, the pitch of which varies with the setting of the tuning capacitor. But gain and selectivity will be obtained with the control advanced just to the verge of oscillation, although if you find that the volume is too great in this position, you can reduce it by turning the regeneration control further back.

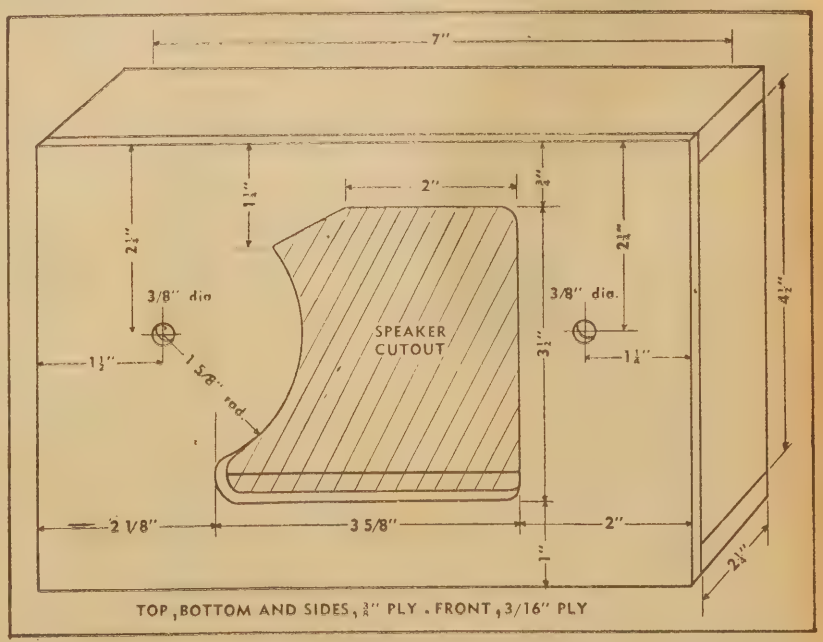
If you live close to a station you will be able to obtain good results with a piece of wire a few feet long for an aerial. In this case the aerial should be connected to the tap most distant from the earthy end of the winding. As the aerial length increases, best results will be obtained with the connection made to taps lower down the coil until, with very long aerials, the tap one turn from the earthed end will give the best results.

(Continued on Page 83)

REAR VIEW OF METAL BRACKET



Parts attached to the metal plate are identified here. Wires between the bakelite strip and plate should be left long enough for the two to be separated.



This neat cabinet can easily be constructed from 3/8in ply and 3/16in ply. If you use materials of other thicknesses appropriate modification should be made to the panel dimensions. Corners should be rounded.

U. R. D. FOR

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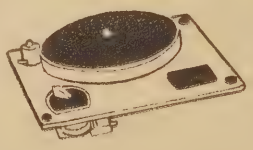
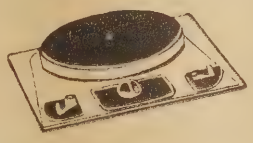


GARRARD 301 TRANSCRIPTION MOTOR



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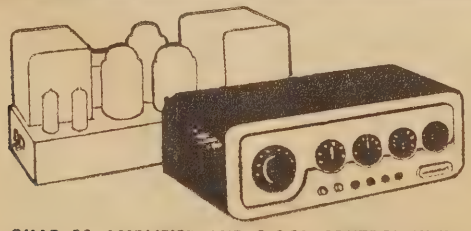

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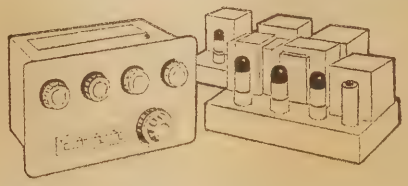

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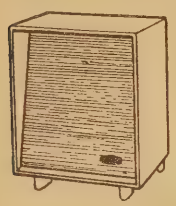

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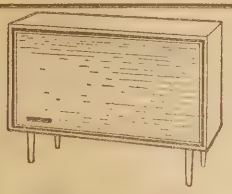
Axiom 300

GOODMANS SHERWOOD 11

Balanced 3 — Radiator Twin-unit, Full-range, High-Fidelity Loudspeaker System. Bass and middle registers reproduced by an Axiom 300. At 5 Kc/s. signal is transferred to Trebax pressure-driven, high-frequency unit. Overall range, 30 c/s.-16,000 c/s. Capacity: 15 watts. Dimensions: 25½" x 23½" x 20½". Polished walnut or pine. Plans available.



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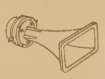

Midax 650

Audiom 60

GOODMANS AXIOM 15/4

Entirely new quadruple Radiator Full-range, High-Fidelity Loudspeaker System. Overall frequency range, 30 c/s.-16,000 c/s. Bass Unit: Audiom 60 12" single-cone unit (30-950 c/s.). Mid Range: Midax 650 pressure-driven horn unit (950 c/s.-5,000 c/s.). High Frequency: Two Trebax pressure-driven horn units (5,000 c/s.-16,000 c/s.). Capacity: 15 watts. Dimensions: 19" (plus 7" legs) x 36½" x 13¾".

Trebax

Midax 400

Audiom 80

GOODMANS 325

Complete Three-unit High-Fidelity System. Overall frequency range: 30 c/s.-16,000 c/s. Bass Unit: Audiom 80 15" single-cone unit (30 c/s.-750 c/s.). Mid Range: Midax 400 pressure-driven horn unit (750 c/s.-5,000 c/s.). High-Frequency: Trebax pressure-driven horn unit (5,000 c/s.-16,000 c/s.). Capacity: 25 watts. Dimensions: 33" x 22" x 20½".

Axiette

GOODMANS AXIETTE CABINET

Single-unit High-Fidelity Loudspeaker System. Frequency Range: 40 c/s.-15,000 c/s. Axiette speaker gives excellent angular coverage at all frequencies. Power output—6 watts, yet only 8 inches in diameter. Operating at normal room volume, the most critical listener would be unable to distinguish between Axiette and more expensive systems. Dimensions: 24" x 17" x 9¾". Ideal for Stereo.

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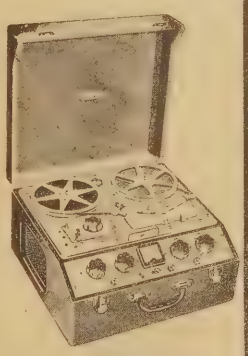
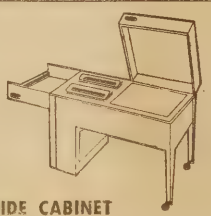
The 3S series incorporates all the basic features of incomparable Ferrograph design, specially developed for Stereo reproduction from tapes. The 3S functions as a normal monaural recorder but by the attachment of the Stere-ad unit, also as a stereophonic player.
Model 3 S/N: 3¾ x 7½ i.p.s.
Model 3 S/H: 7½ x 15 i.p.s.
Stere-ad unit suitable for both models.





QUAD CHAIRSIDE CABINET

Veneered in mahogany and walnut this specially designed chairside cabinet will accommodate the Quad II control unit, FM or AM tuner, and a suitable motor and pick-up arm on the playing table. The Quad II main amplifier fits into the well-ventilated compartment below.

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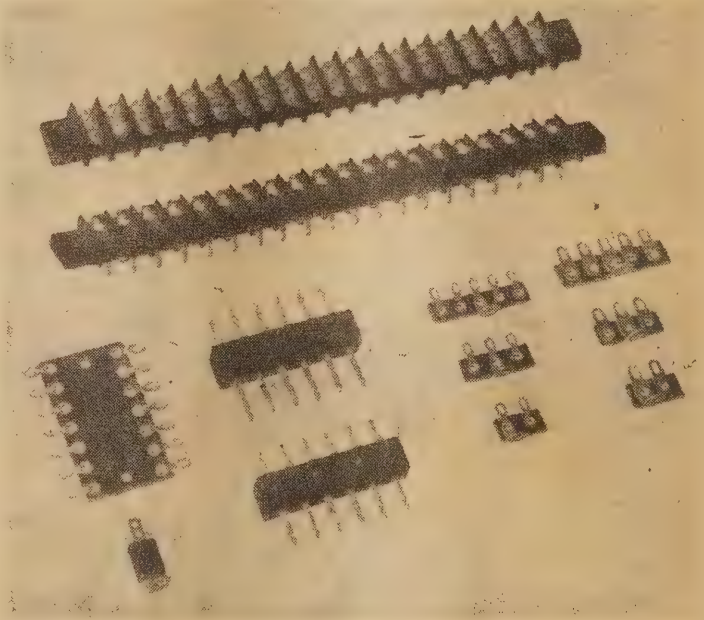

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FROM THE SERVICEMAN WHO TELLS

Electrical interference normally produces recognisable patterns on a TV screen, which the experienced serviceman will nominate with quite good accuracy. However, a TV set can produce its own interference when things go wrong in the EHT system, and the cases I am about to relate demonstrate this quite forcibly.

IN the first one, the symptoms had been described by the owner as a series of short dark streaks over the whole area of the screen; as nearly as I could gather very much like a severe case of ignition interference—except that there was no possible source of interference capable of producing such a severe effect on a continuous basis.

The owner—apparently with the idea of saving cost—was all for loading his set in his car and delivering to my doorstep, but I hastily discouraged that idea. I wanted to see the set misbehaving in its natural habitat. If the trouble was outside interference it would be plainly useless to check it in a workshop several miles away while, if it was in the set, the less the latter was disturbed before I saw it, the better.

NO EXAGGERATION

When I finally did see it, I had to admit the owner had not exaggerated. The interference was really severe. What was more, he had taken the trouble to check with a couple of his neighbours and was able to report that they were experiencing no such trouble. This was quite a useful piece of information since it meant that the trouble almost certainly was in the set.

As I hinted earlier, the EHT system is the most usual offender in these cases. Because of the high voltages and angular waveforms associated with this part of the set, a breakdown in insulation usually results in sparking and severe radiation. The fact that we start with a frequency of 15 Kc, rich in harmonics, means that such radiation easily can find its way into the IF or tuner circuits.

Such troubles frequently are found by simply looking and listening. The spark may be audible or visible, or both, and a keen ear and eye usually brings success. (Not a very scientific sounding approach, perhaps, but an essentially practical one.)

FAINT BLUE GLOW

This one was easy. I opened the back of the cabinet and immediately noticed a faint blue glow on the back of the EHT cage. It wasn't the actual spark, merely the reflection of it, but it was fairly obviously originating outside the cage rather than in it.

Mounted flush with the back of the main chassis and extending several inches above it was a narrow metal panel which supported the yoke socket. Both sight and sound suggested that the trouble was behind this panel, and a closer look confirmed my suspicions.

Mounted across the yoke socket was a tubular ceramic capacitor forming part of the balancing network designed to minimise coupling between the horizontal and vertical deflection coils. Although I could not see exactly why at this stage, it was obvious that one end had come adrift from the socket terminal and was merely resting against it in random fashion. Judging from the pattern on the screen, the sparking was equally random.

A DRY JOINT

The capacitor was partly hidden by a resistor immediately above it (also part of the yoke network), but I was able to push the broken end of the capacitor away from the socket with an insulated lining tool. This temporarily cured the trouble, but I fully expected to see a pattern of wavy lines on the left hand side of the screen, as a result of the unbalance between windings. Strangely enough, this was not evident and, had I wished to, I could have left the set as it was.

However, tricks like that never pay in the long run and, in any case, I was anxious to see just why the capacitor had broken loose. With a little juggling I was able to get a better look at things without having to take the chassis out of the cabinet, and even managed to get a small soldering iron in behind the socket.

By unsoldering one end of the resistor and moving it out of the way I was able to get a good look at the socket contact and the end of the capacitor pigtail. I'm afraid I ticked up a black mark against the manufacturer when I did, because the joint was a typical "dry."

As is usually the case with faults of this kind, the repair was something of an anti-climax. Just a few moments work with a hot iron and some good quality solder and the job was done, the set as good as it should have been when it was new, and the customer happy once again.

I suppose, considering the number of joints in one set, the advent of one dry joint in an occasional set represents an almost negligible percentage and, from the manufacturer's point of view, just about the irreducible minimum. On the other hand, and from the customer's point of view, one dry joint in one set (after all, he is not concerned with all the other sets) can represent a lot of trouble and expense.

FORTUNATE OWNER

In this case the owner was more fortunate than many, because the trouble was easily located and easily repaired. Had it been intermittent it could have caused both of us a lot of bother. Even as it was, it involved the owner in the cost of a repair which should never have been necessary.

In the second case the symptoms were quite different. It still consisted of short interference streaks as before, but these were now confined to a narrow vertical area almost exactly in the centre of the picture.

A flashover between the EHT lead and the EHT rectifier plate, occurring for a brief period only during each line scan when the voltage difference was greatest, produced a pattern like that shown above. It differs markedly from the random patterns produced by other forms of EHT breakdown.

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When interference takes on a definite pattern like this it is even more certain that the trouble is internal. In this case it meant that the trouble occurred once every line at a point half way through the trace, and it would be unlikely that a source of external interference could run at exactly the required frequency.

(There are two possible exceptions to this. One is where the external source in another TV receiver, defective in a similar manner, which is radiating the interference into nearby sets. The other is where the interference is synchronised vertically rather than horizontally, due to leaky power line insulators, both the frame frequency and the interference being derived from a nominal 50 cps source.)

HT FLASHOVER

Removing the back of the cabinet I was able to detect the unmistakable hiss of a HT flashover, and it was obviously inside the cage somewhere. More than that I was unable to determine until I removed the chassis from the cabinet.

Even then I couldn't see it, or even a reflection from it which might provide a clue. I had not removed the cage cover at this stage, hoping that I might be able to pinpoint the area without disturbing anything. As it turned out, it was as well I did.

I went around the room drawing curtains and pulling down blinds until I had darkened it as much as possible. Then I had another look and spotted the trouble immediately. The EHT lead was running much too close to the plate cap of the 1B3 EHT rectifier and there was a merry little spark jumping between the two.

Repairs were simple. I moved the lead away, checked that it cured the trouble, then re-arranged the lead so that the trouble would not occur again. It took no more than a few minutes and it was not even necessary to remove the cage cover.

The interesting point about this fault is that the flashover was not a continuous or random process as in the previous story. In the present case, breakdown was occurring for a very brief period only, once every line cycle.

NOT CONTINUOUS

Presumably, the spacing between the EHT lead and the 1B3 plate was just sufficient to allow a breakdown when the voltage between them was greatest. While the voltage on the EHT line is essentially constant with respect to chassis, due to the action of the final filter capacitor, the voltage on the 1B3 plate varies between approximately this same voltage, and several thousand volts negative during the negative half cycle.

While it is difficult to work out all the ramifications which this implies, and relate them exactly to the position of the trace on the screen, it seems certain that the flashover was occurring at a moment of maximum negative swing at the 1B3 plate.

A third story, in similar vein, was related to me by a colleague. In this case the symptoms could have been quite deceptive. The picture had taken on a form of distortion sometimes called "gear wheel effect" and usually associated with hunting or similar troubles in the horizontal oscillator.

In this, straight vertical lines are displaced in either a sine wave pattern, as in this case, or a square wave pattern (the true gear wheel effect), depending on the actual cause of the trouble. In either case the effect is quite ludicrous. The sight of the Lone Ranger's trusty nag galloping across the prairie with three cycle sine wave legs is enough to raise a laugh from the most cynical TV viewer.

All except this customer, that is. He was so horrified at the effect, and the possible financial implications, that he was quite unable to see the funny side. He rang my colleague in a frightful panic, convinced that nothing short of a defunct picture tube could cause such a ghastly effect.

My colleague was able to allay his fears on that score, pointing out that, whatever it was, it certainly wasn't the picture tube. To himself, he registered that it almost certainly was in the line oscillator AFC system, the symptoms being indicative of some form of hunting condition.

When he finally came face to face with the set, he found the picture almost exactly as the owner had described it. Only one point had been overlooked: the fact that the screen was covered with short dark "ignition type" interference lines but which, quite obviously, were not ignition pulses.

Cocking an ear to the back of the cabinet confirmed his suspicions: there was the unmistakable sound of sparking from the general vicinity of the cage. Unfortunately, it could not be localised without withdrawing the chassis part way out of the cabinet, where he had a clear view of the cage.

EASY CURE

Then it was immediately obvious. One of the low tension leads in the cage had somehow been moved into proximity with the EHT transformer and was sparking away in fine style. My colleague was able to move it clear without removing the cage, and tuck it out of the way so that it would not cause trouble again.

And, believe it or not, that was all that was needed to cure the "ignition" pulses and straighten the faithful Silver's sine wave legs.

Why?

Frankly, I don't know. My colleague being a serviceman who doesn't have to tell, is notoriously unobservant in cases like this. He was unable to tell me anything more than I have already related. The exact wire involved in the cage, or the exact part of the EHT transformer to which it was breaking down, must remain a mystery and, without this and other information, one can only guess as to the exact cause behind the effect.

Nevertheless, I felt that the story was worth retelling as an example of the troubles which can arise when things go haywire in the EHT system. If it helps some reader to spot a similar fault more quickly than he otherwise would have done, it will have been worthwhile.

Incidentally, have you noticed how hopelessly tangled some people become when they try to describe a TV fault. I happened to be visiting a colleague earlier today when a customer arrived with a tale of woe about a TV set. I must have listened to his attempted description (so garbled as to be almost embarrassing) for nearly ten minutes without getting more than the vaguest idea of what was worrying him.

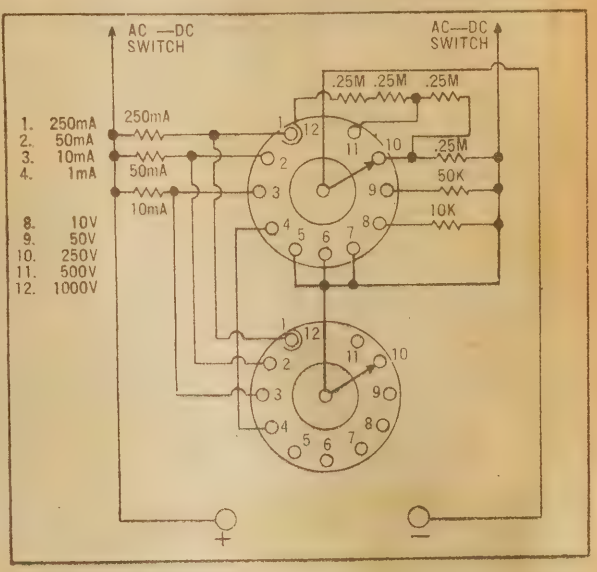
DIFFICULT DEFINITION

The picture was first described as "out of focus", but some very patient probing on my colleague's part eventually revealed that this was really severe vertical non-linearity at the top of the picture.

When I left, he (the customer) had progressed to the subject of "brightness" and "clarity." He stumbled along, his story punctuated with innumerable "likes" and "you knows," but without being able to convey any sense at all to either myself or my colleague. I imagine the latter will listen politely, then take a trip out to see the set and have the owner demonstrate the trouble.

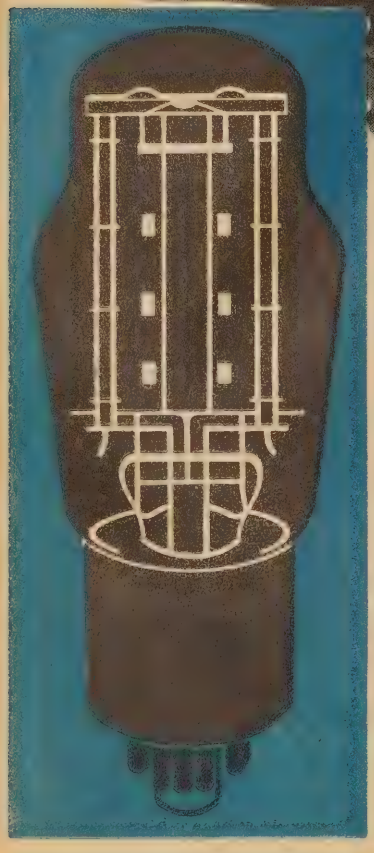
Otherwise he might just as well be talking Hindustani for all the sense he makes.

And that is probably enough TV for one month. By contrast, my next story concerns a humble multimeter. It would not have warranted much attention in the usual way, but it did cause me to stop and think about something which everyone, amateur and commercial manufacturer alike, seems to have very largely ignored. I refer to the voltage



The relevant portion of the modified multimeter circuit, showing the 1000 volt range shifted from position 11 to position 12. Since the latter must share its position on the wafer with position 1, and the insulation between these contacts is rated at only 300 volts, it is not surprising that it broke down when over 1100 volts peak was applied.

PEOPLE WHO KNOW . . .



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rating or insulation properties of ordinary wafer switches as used in multimeters.

It all started when a friend, a keen home builder of radio gear, was relating a sad experience with his own (home-made) multimeter. It was a fairly standard job, based largely on the Standard Multimeter circuit described in "Radio and Hobbies" of September, 1950, but with one or two modifications to permit the use of parts already on hand.

The main one, as far as this story is concerned, involved the switch wafers. The original circuit used two 1 x 11 wafers in conjunction with four input terminals to achieve the usual combination of four voltage, four current, and four resistance ranges. However, my friend had discovered in his junk box a switch which contained two 1 x 12 wafers, and had decided to use this rather than buy a new one.

Following on this decision came the idea that the extra position might be put to some use. A few moments' study of the circuit showed that it would be a simple matter to tap into the 1,000-volt multiplier network (four .25 M resistors in series) to provide a 500-volt network. This could be wired to "position 11," previously used for the 1,000-volt connection, while the 1,000-volt connection would now go to "position 12."

ERRATIC BEHAVIOUR

While admitting that a 500-volt range was not a staggering addition to the instrument, he pointed out that it could be useful on occasions, as well as having the very real advantage of costing virtually nothing. I'm afraid it is very hard to argue against that kind of reasoning, even had I wanted to.

For a long time the instrument had behaved in a perfectly normal manner, becoming a reliable "old faithful" which performed the greater part of the routine measurements associated with my friend's hobby.

Then, while engaged in measuring the output of a large power transformer, delivering some 800 volts, the behaviour of the meter suddenly became erratic, the needle wandering up and down the scale without any true relationship to the supply voltage.

Opening the case released a smell of burning bakelite, and when the voltage was applied again, the cause of this was immediately apparent. Somewhere beneath the 1,000-volt contact some kind of flashover had occurred and, in fact, was still occurring. The light from it could be seen quite distinctly through the bakelite, the actual trouble occurring somewhere inside the contact assembly.

SWITCH CONSTRUCTION

In order to fully appreciate what happened, it is necessary to consider the construction of the switch, and in particular the "No. 12" contact. As with most switches of this type, this position is really an extra—something which can only be provided by means of a certain amount of juggling.

In fact, it must share the same position on the wafer as contact No. 1, held by the same rivet, but on the opposite side of the wafer and insulated by means of suitable insulating spacers. The most elementary examination of the arrangement makes it plain that the clearance between these two contacts must be very small indeed.

In this circuit, contact No. 1 was wired to the 250 mA shunt, the other side of which connected directly to the negative input terminal. Thus, the full input voltage was applied between these two contacts (1 and 12) whenever the 1,000 volt position was used. In this case a peak voltage of something over 1,100 volts (800 x 1.4) was involved while in the event of 1,000 volts AC being measured, a peak voltage of over 1,400 would be applied.

In many ways it was not surprising that this had broken down, but I was rather puzzled on one point. Many published circuits appeared to ignore this point completely and it seemed that some commercial manufacturers also may have made the same error.

CARE WITH CONNECTIONS

However, a closer study of typical circuits showed that they had, either by accident or design, avoided this extreme condition in most cases. The simplest precaution was to juggle the switch positions so that either the 1,000 volt contact was other than No. 12 or, if this arrangement was retained, the No. 1 contact was used for some other range not connected to the other input terminal.

In fact, I was able to point out to my friend that by simply transposing the current ranges so that the 1 mA position replaced the 250 mA position, most of the danger would be avoided. As can be seen from the circuit the 1 mA contact is wired to the corresponding contact on the next wafer which, other than when the 1 mA range is selected, goes nowhere. A breakdown in these circumstances would be extremely unlikely.

Nevertheless, now that my curiosity had been aroused, I was anxious to discover just how much voltage could safely be applied between such contacts —or between any other switch contacts for that matter.

Accordingly, I telephoned one of our major switch manufacturers and put the question to them. The engineer concerned was most helpful and was able to supply some very useful information.

MODEST RATINGS

In spite of my own ideas concerning the insulated contact, it was still something of a shock to learn that the rating for this was only 300 volts. Equally surprising were the remainder of the figures quoted: Between adjacent contacts, 500 volts; between contact and rotor, 500 volts; between rotor and shaft, 500 volts; between contact and spacer (pillar), 300 volts.

In other words, no part of these switches, theoretically, is capable of withstanding more than 500 volts. How is it, then, that commercial instruments allow nearly three times this voltage to be applied to them—and, very obviously, get away with it?

I can only assume that the meter manufacturers have placed a somewhat liberal interpretation on the switch manufacturers' statement that these figures are "rather conservative"; a liberal interpretation which, however, seems to be justified by results in practice, because trouble of this kind is extremely rare.

In those cases where this trouble has occurred, it has often been traced to the use of paste type fluxes. When I mentioned this to my friend he admitted

(Continued on Page 83)

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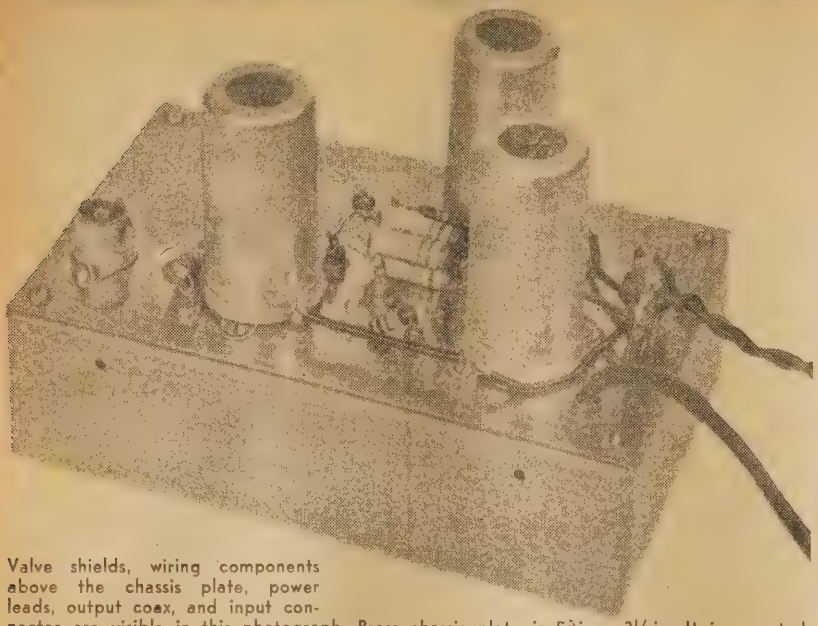


Valve shields, wiring components above the chassis plate, power leads, output coax, and input connector are visible in this photograph. Brass chassis plate is 5⅝in x 3½in. It is mounted in a metal box 1¾in deep with a removable baseplate. A cover with ventilating holes would be a worthwhile addition. This would allow a clearance of about 2½in.

Converter Design For The 50 Mc Band

Although the 50 Mc Amateur band hasn't as much all round employment as the 144 Mc band, it is of great value, and is an ideal starting point for beginners who use simple equipment. These three circuits cover the reception field, and are all intended for use with a receiver tuned to the HF bands operating as the IF and audio circuits of the system.

IN our last month's issue, we published a detailed description of a crystal controlled 144 Mc converter of good performance, and suitable for use with a communications type of receiver tuning from about 5-12 Mc for full coverage of the band 144-148 Mc.

This converter was designed by Bob Winch, VK2OA, and was adopted by the VHF Section of the N.S.W. Division of the Wireless Institute of Australia as a standard circuit for construction by its members.

In this issue we are giving the details for coils which will allow the converter to be used on the 50-54 Mc band.

Although in recent years this band was replaced by one between 56-60 Mc, it was restored by the P.M.G. so that Australian amateurs could participate more easily in the activities during the Geophysical Year, as it is widely used by overseas amateurs, particularly those in America and the Pacific.

Its occupancy has been extended for the time being, until such time as it will be required for use by Australian TV stations.

A VALUABLE BAND

The coil data we have given could be easily amended to be useful for the 56-60 Mc band by slightly reducing the number of turns if found necessary.

The 50 Mc band is not as popular among VHF enthusiasts as it should be, and we hope the publication of this data, together with the other circuits for 50 Mc, will inspire more of our readers to use it.

It is particularly valuable when distant stations are audible during the summer months. For some years it has produced a wealth of interstate communication, and on numerous occasions with stations in the Pacific area. Unfortunately when propagation conditions which allow such communication lapse, there are periods when activity is not high.

And yet it is an excellent band, particularly for those who do not wish to build complicated equipment, or have not the facilities to do so.

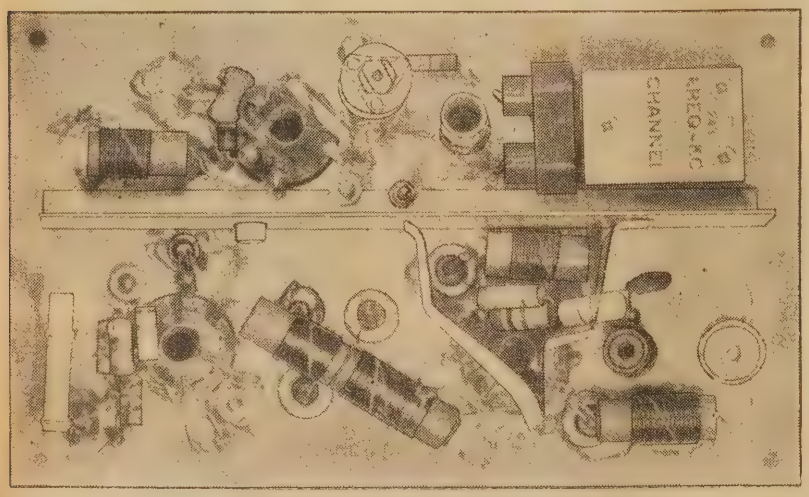
Unlike the band at 144 Mc, to which most VHF operators tend to drift, quite simple receiving and transmitting designs will work very well, and the larger elements in the aerial system are really the only disadvantage.

The 50 Mc band is the lowest available frequency for which techniques commonly used on the lower frequency bands can be successfully employed. The jump to 144 Mc is enough to show up the limitations of many valves and circuits so that, for high efficiency, new methods are to be preferred.

This converter is a case in point. At 144 Mc, the noise entering the receiver from the aerial circuit is much lower than at 50 Mc, but it is harder to get good performance from the valves, and the noise factor of the receiver front end, in this case the converter, becomes very much more important.

The cascode circuit is probably the easiest and least critical method of achieving a satisfactory performance, and that is why it was used.

On 50 Mc the noise figure which can



An underchassis photograph of the converter showing the position of the coils for 50 Mc.

COIL DATA FOR 50 Mc.

The following data was supplied by the WIA for 7MC crystals and ⅜ formers.

L1—8 turns of 30 SWG close wound spaced 3/64 inch from L2.

L2—16 turns of 30 SWG enamelled wire close wound on 5/16 inch former with slug.

L3—9 turns spaced ⅝ inch with slug.

L4—15 turns centre tapped spaced ¾ inch no slug.

L5—10 turns spaced ⅝ inch no slug.

L6—19 turns spaced ½ inch with slug.

L7—14 turns spaced ⅝ inch no slug.

LN—9 turns spaced ⅝ inch with slug and 7½pf capacitor in parallel.

Coils L3 to L7 wound with 22-24 SWG enamelled wire.

The following data is our own for 5MC crystals and 5/16 formers.

L1—8 turns closewound.

L2—27 turns closewound in same direction as L1. No space between coils with slug.

L3—11 turns spaced ⅜ inch with slug.

L4—15 turns spaced ½ inch with slug.

L5—9 turns spaced ⅝ inch no slug.

L6—22 turns spaced ½ inch with slug.

L7—13 turns spaced ⅝ inch with slug.

LN—9 turns spaced ⅝ inch with slug and 10 pf capacitor.

All coils wound on 5/16 inch formers with 24SWG or 26 B & S enamelled wire.

be obtained is even better than at 144 Mc, but its value is much less. It is so far below the noise picked up by the aerial that a much less favourable figure is practicable without noticeably affecting reception.

The noise figure of the 3-valve tuneable converter given herewith is so close to that of a cascode as to be indistinguishable in use, while that of the single valve converter is still good enough to allow reception of all signals with the possible exception of the weakest DX.

Because of the detail with which the cascode has been described, however, and because the crystal control has its advantages, the inclusion of 50 Mc coils are considered amply justified.

NOT INTERCHANGEABLE

Unfortunately the layout of the converter makes it almost impossible to make the coils interchangeable, but the value of this is doubtful. Because the converter is not really a major project

COILS FOR 3 VALVE TUNEABLE CONVERTER

Aerial Coil—8 turns spaced one diameter, tapped at 1½ turns for aerial connection and 3 turns for the gang.

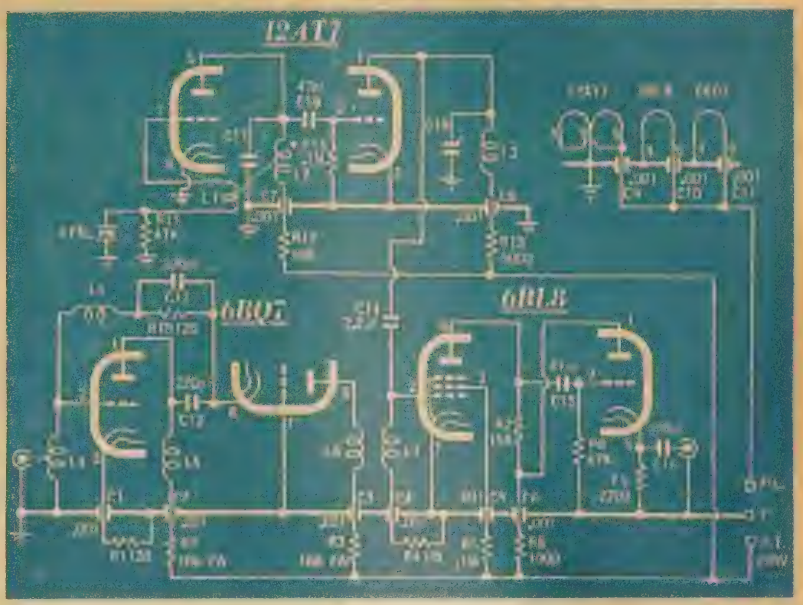
Mixer Coil—7 turns spaced one diameter, tapped at 3 turns for the gang.

Oscillator Coil—4 turns spaced ¾ inch tapped one turn for the cathode Gang connected across the full coil.

All wound with 16 gauge tinned copper wire and ⅝ inch in diameter.

Output coupling coil has 44 turns of 44 gauge SWG enamelled wire close-wound. Output coupling coil has 5 turns wound over the bottom end, using same wire.

50Mc XTAL CONVERTER CIRCUIT



A feature of the converter is effective bypassing to the chassis plate with lead-through type ceramic capacitors. The chassis plate is indicated above by heavy lines.

either in cost or complexity, many will like to have one for each band, using the same receiver in each case.

The original coil data as supplied by the WIA was for 3/8in formers which apparently were available at the time, but we wound ours on standard RCS slugged formers which are nearer 5/16th in diameter. These formers come with a base attached, but we cut them to the required length and discarded the remainder.

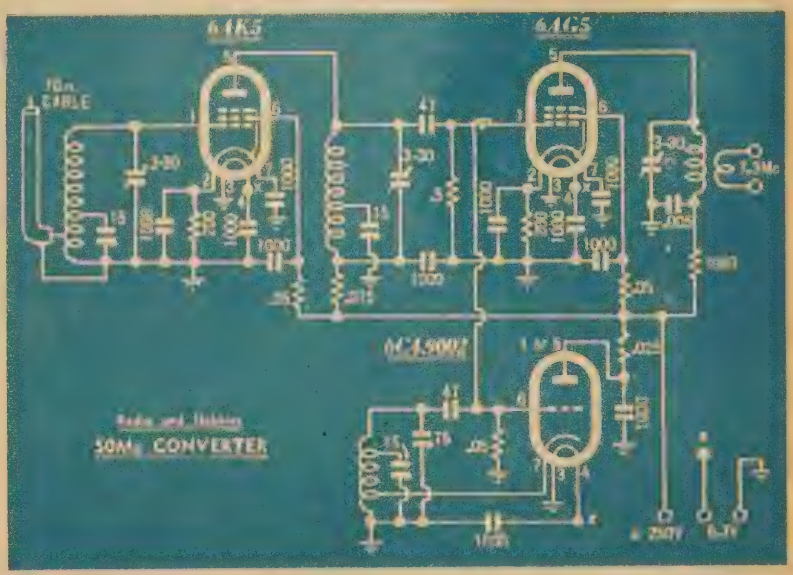
The data given should allow you to use any type of former of these approximate diameters. Changes in the exact number of turns can be worked out by adding or subtracting turns in direct ratio to the variation of former diameter from those given. In some cases the slug adjustment will be enough to make up the difference.

The oscillator of the 50 Mc converter is likely to be easier to handle than that for 144 Mc, if only because the order of total multiplication is not so great.

The frequency of the crystal should be such that, when multiplied, the resultant is a frequency lower than 50 Mc by the amount of the IF you have selected.

In our case, for instance, we used a 5 Mc crystal, operating on its third harmonic, so that the actual oscillating frequency was 15 Mc. The frequency multiplier, again operating on the third harmonic, gave a total figure of 9 times, and a final frequency of 45 Mc.

As this is 5 Mc lower than 50 Mc,



Note double earthing of 6AK5 and 6AG5 cathodes. Bypassing the "hot" filament lugs is wise but not essential. This circuit in general will suit various valve combinations.

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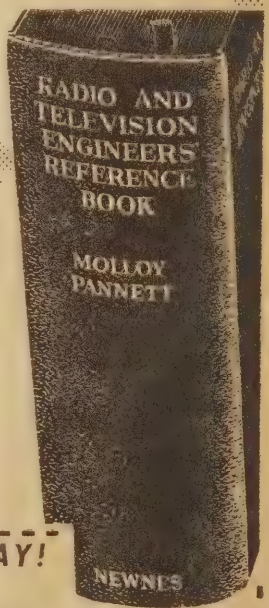

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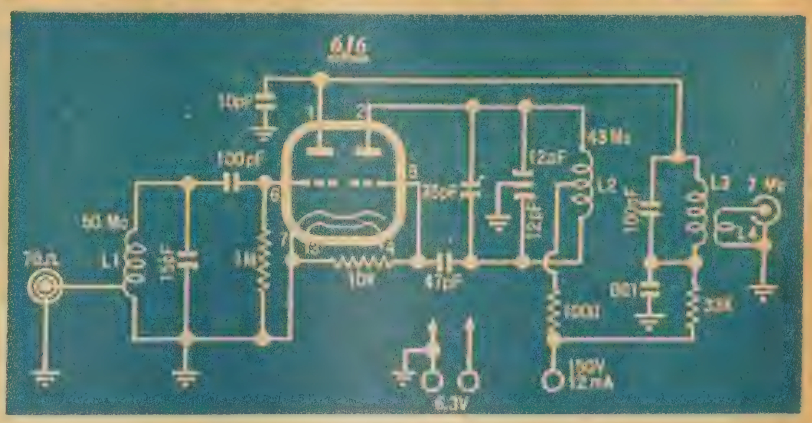
COILS FOR 6J6 CONVERTER

L1—7 turns 18 gauge tinned copper wire ⅝ inch diameter, 7/16 long tapped 2 turns from grounded end.

L2—Same as for L1 but centre tapped for connection of resistor.

L3—29 turns of 24 gauge enamelled wire 5/16 former with slug, close wound.

L4—4 turns 24 enamelled wire at cold end of L3.



Circuit of a simple single valve converter for 50 MC. Valves such as the 12AT7 are equally suitable—both cathodes to be earthed.

the receiver with which the converter is used tunes to 5 Mc for 50 Mc signal, and 9 Mc for 54 Mc signal frequency.

With a 7.5 Mc crystal, the oscillator could work on the third harmonic and double in the multiplier. This would give a total of 6 times, and again a final figure of 45 Mc for a 5 Mc IF at 50 Mc signal frequency.

With a 7.166 Mc crystal, a total multiplication of 6 times would work out at 43 Mc, in which case a 7 Mc IF would be needed for 50 Mc signal frequency.

In fact, any crystal within these general limits can be used, and it is quite easy to work out which receiver frequency will be needed as the IF to obtain the 50 Mc signal frequency at the converter.

Tuning of the receiver will be simplified if 50 Mc corresponds with an easily readable figure on the dial, for it is easier to use calibrations which start at 5 Mc than at 5.13 Mc, for instance, as might happen with an odd crystal frequency.

If a crystal around 7 Mc is used, the same plate coil for the oscillator can be used for the 144 Mc converter described last month. Some amendments are needed for crystals near 5 Mc.

Because of the lower order of multiplication, there should be ample injection voltage for the converter.

Winding the wire on the formers presents a problem of anchoring the ends to that the winding is neat and tight.

This can be done by tying a few turns of thread around the commencement of each winding, and painting with coil dope. In a few minutes the wire will grip quite well, and the winding can be finished off in the same way. A good coat of coil dope will make the coils self-supporting, and they can then be mounted into the converter by the ends which are cut to suit.

A grid-dip oscillator is useful in bringing the slugs to their approximate tuning positions. But the cascode, being a broadly tuned device, isn't particularly critical in this respect, and it will work reasonably well even with mis-adjusted coils.

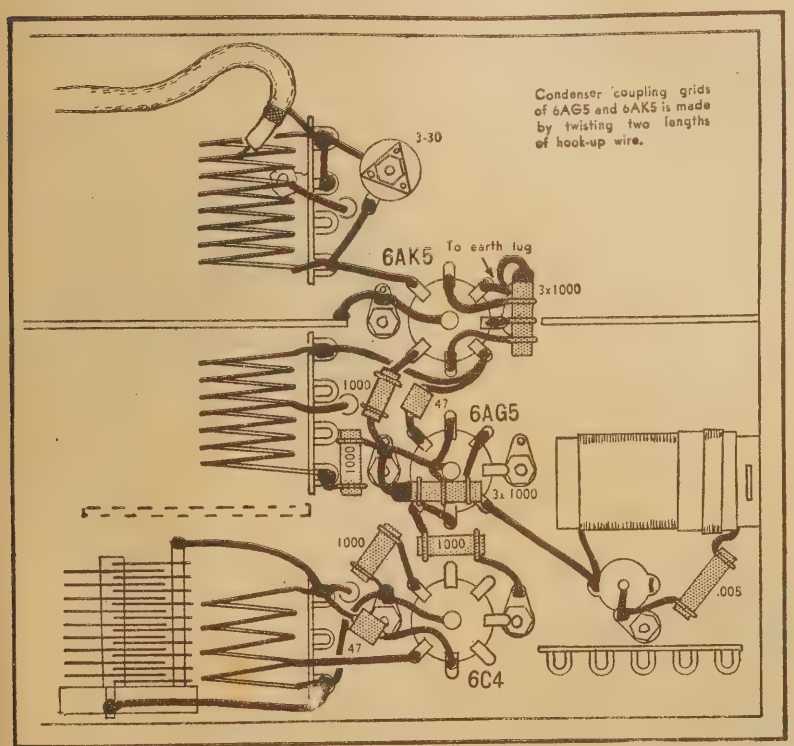
The only critical adjustment is to the oscillator plate coil which must be correctly set if the crystal is to assume control. The easiest check is to tune your receiver to the third harmonic — in our case 15 Mc. With the BFO turned on, an immediate and unmistakable heterodyne will be heard when the crystal oscillates. One advantage of the 5 Mc crystal is the comparative ease and certainty of its harmonic oscillation, and the fact that nearly every receiver will tune to 15 Mc as a check on its operation.

The other coils which should be correctly adjusted are L3 and L6. It is normally not necessary to use a slug in L7, which is fairly tightly coupled to L6.

The aerial coil is so broad that it will be difficult to find a response on the GDO.

For further details on the adjustment of the converter, the reader is referred to the article in last month's issue.

The second converter shown here was originally described in February, 1953, and has been in service ever since. The only change has been to use a 6AM6 in place of the 6AG5 with a small improvement. It is a standard superhet circuit with a tunable oscillator and valves which may still be obtainable from disposals. In performance it is equal to anything we have used to date.



Underchassis layout for 3-valve tuneable converter. Use ceramic bypass capacitors and keep leads short. The output coil is at the right. Note leads to the gang disappearing through holes in the chassis.

STABILITY

Use of a tunable oscillator means that the mechanical stability is not as good as for a crystal controlled converter, although the oscillator could be crystal controlled by using one of the circuits shown for the cascode.

Nevertheless, after the warm-up drift has stopped, as it does in a few minutes, its stability is good enough for the converter to be dropped bodily from several inches to the operating table without detuning the station received. Solid mounting of oscillator components and a stout chassis are the best ways to ensure good stability.

The three-gang tuning capacitor was originally a disposals type, and as it is not always easy to procure one, this could be a disadvantage of the circuit.

The wiring diagram on this page will

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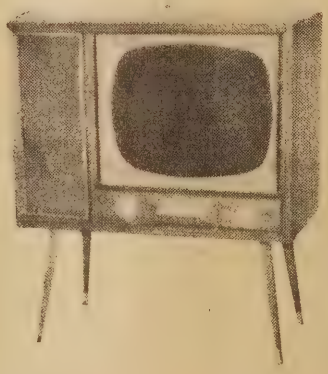

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show all essential details of construction. The gang is mounted above the chassis and the leads to its sections are easy to identify. Small shield plates are mounted between all three coils.

Tracking is obtained firstly by the different LC ratio of the oscillator coil and secondly by attaching the gang sections to taps along the coils themselves which are large enough to make this a fairly easy matter. Aerial and RF coils are trimmed with 3-30 pf concentric trimmers.

All RF bypasses should be tubular or disc ceramics with short leads and central earthing for each section.

Coupling between oscillator and mixer grids is through a small twisted lead capacitance, or about 3 pf capacitor.

The converter is used with a receiver which tunes to approximately 7 Mc and the output coupling coil is adjusted to this frequency.

The simpler 6J6 converter is of a type used by hundreds of amateurs and was taken straight from the ARRL Handbook. Absence of an RF stage lowers its gain and makes aerial coupling a little more critical, but it is perfectly satisfactory for local use where its performance might be indistinguishable from a more elaborate type.

It is also the easiest and simplest to build, for it is probably easier to obtain a small two-gang capacitor than a three gang.

Provided normal care is taken to keep leads short the layout is not in any way critical. Again the mounting of all oscillator components should be as rigid as possible to minimise mechanical instability. It is an excellent converter as a first effort, and has even been used on 144 Mc with good results.

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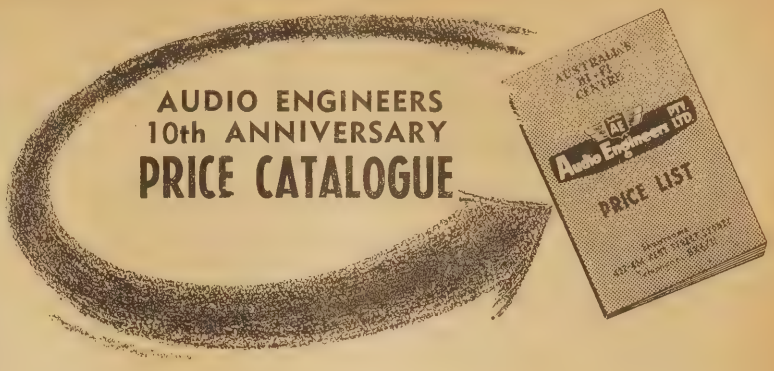

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The Story Of The Stylii

This article, one of a current series in "Hi-Fi News," was written by the English authority on audio equipment. Stanley Kelly. In reviewing the performance of record stylii, both as regards material and point size, the results of actual experiments are particularly valuable, if only because they are not easy to obtain. Stanley Kelly has had considerable experience in pickup design.

THE advent of stereophonic discs has placed new demands on gramophone styli. Because the geometric distortion of the 45/45 stereo disc is greater than that occasioned by normal lateral single channel recordings, the radius of the point has to be reduced considerably. It is unfortunate that this reduction of the radius of the point carries with it the attendant disadvantage of increased pressure loading for a given playing weight, and hence increased wear of both the stylus and the gramophone record.

About twelve months ago, the writer investigated the design parameters for optimum stylus and record life. It was shown that the wear of the record with a one thou radius point was considerably greater than had originally been anticipated. Since then the investigation has been continued, and the life of the stylus or, to be more correct, the size of the "flats" worn on the stylus tip, has been evaluated in terms of playing weight and playing time.

Test conditions

These experiments were performed using new discs in an air-conditioned room with the lid of the record player closed. A **Dust Bug** was not used because these evaluations have been performed in the interests of the industry at large, rather than that of the hi-fi enthusiast who takes much greater care of his equipment than the average domestic user.

Graph, **fig. 1,** shows the stylus life for different playing weights. It is plotted in terms of "flat" diameter against time, and it is seen that in the case of the diamond stylus three playing weights were used; there were 2 grams, 5 grams and 7 grams. In the case of the sapphire, 5 grams only was evaluated. These were well finished normal commercial points, in which the radius was within two microns of the nominal value. They were especially checked for true sphericity because any flats or other blemishes in form would have negated results to a considerable degree.

Instead of using a pickup, the styli were mounted directly into a small cantilever, in which both the vertical and lateral compliance had been adjusted to 7 x 10—6 cm/dyne, and the effective mass was adjusted to 1 milligram. There should therefore be no difficulties due to the mechanical impedance of the stylus assembly being greater than optimum for correct tracking of the pickups, even at a playing weight of 2 grams. The effective tone arm mass was adjusted to 30 grams

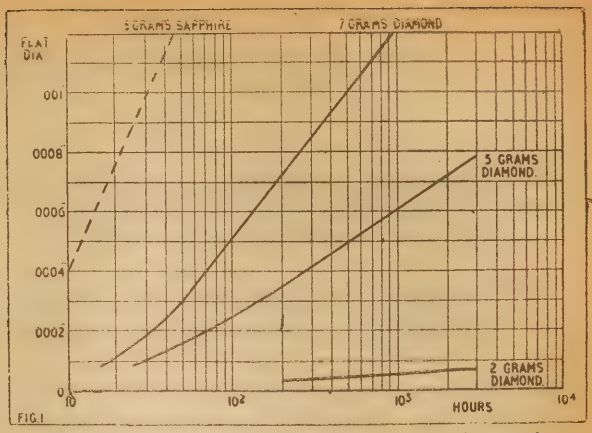

Fig. 1—Radius point .001 inches. Flat size V playing time.

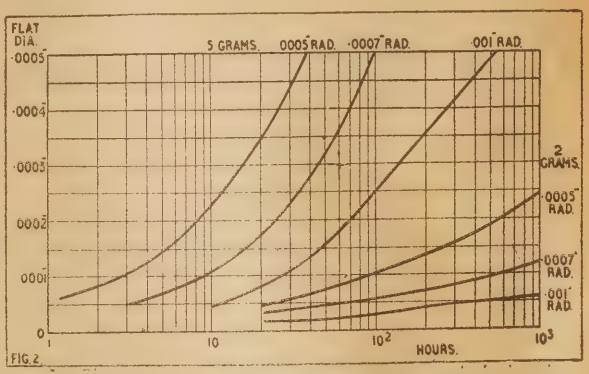

Fig. 2—Flat size V playing time. Different radii and playing time.

and the arm was actually suspended on needle points in order to reduce the friction to an absolute minimum.

The effect of a "flat" is twofold: Firstly, when the size becomes appreciable it forms an extremely efficient cutting tool and literally shaves the corners off the high frequency modulations in the record, thus reducing the high frequency response. Secondly, when the dimension of the "flat" becomes comparable to a wavelength, another form of distortion is introduced which is principally third and fifth harmonic.

This distortion is a function only of the width of the "flat" on the "needle" and the wavelength of the recorded tone. The distortion becomes very severe before there is any appreciable attenuation of the fundamental caused by record wear, and although the harmonics of the higher frequencies (which are the only ones affected) may be outside the frequency range of the equipment, the inter-modulation products will most certainly be apparent.

Distortion from flats

On the innermost grooves of a normal fine groove record at maximum modulation the distortion approaches 20 per cent at 10 Kc/s when the diameter of the "flat" is approximately 0.3 thou. This is third harmonic; the fifth harmonic comes out at about 17 per cent. Admittedly, the frequencies of these components are 30 Kc/s and 50 Kc/s and are quite

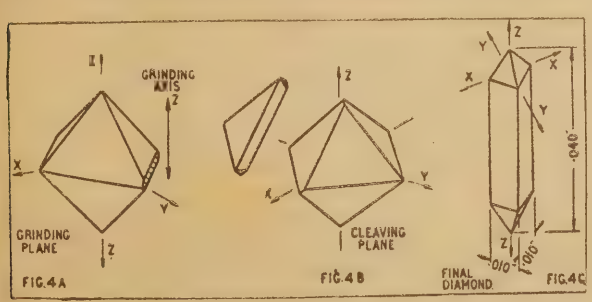

Fig. 3—Diagram showing crystalline form of the diamond and its relative axis.

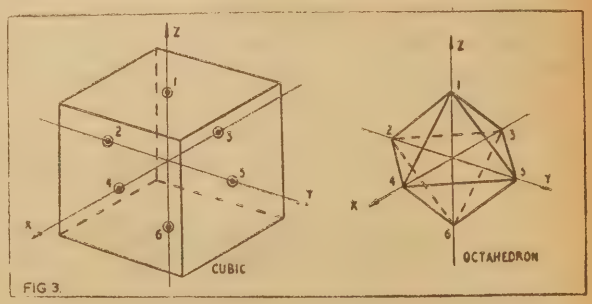

Fig. 4—(a) Grinding and (b) cleaving planes in octohedron diamond. (c) Final diamond block before coning and polishing.

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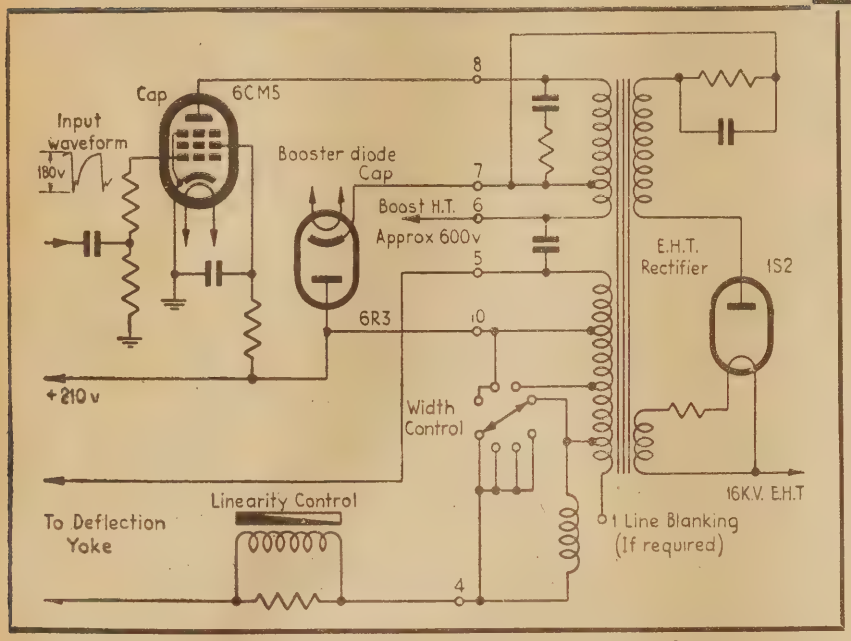
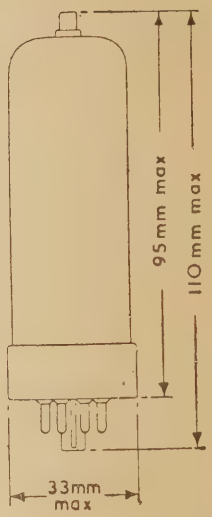




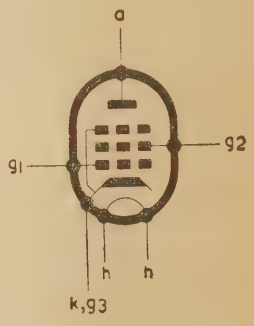
6CM5 CHARACTERISTICS

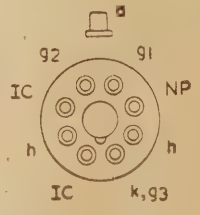
Heater ratings — *6.3V at 1.2A*

TYPICAL OPERATING CONDITIONS 90° DEFLECTION

Anode Voltage Supply (alternative Voltages)	200V	225V
Anode Voltage Boost	460V	472V *(Approx.)*
Total D.C. Supply	660V	690V *(Approx.)*
Screen Grid Voltage	200V	225V
Grid Input Voltage (pk to pk)	145V	145V
Anode Current (D.C.)	110mA	85mA
Screen Current (D.C.)	30mA	28mA

The 6CM5 is a television line output pentode having anode and screen dissipation ratings of 10 watts and 6 watts respectively. Peak anode voltage ratings of 7.0 kV positive and 3.0 kV negative together with a peak anode current rating of 350 mA ensure its suitability for 90° deflection systems with EHT voltages of the order of 18 kV. The reserve margins available ensure long service life. Additional data is available to design engineers on request.





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outside the normal range of hearing or, indeed, that of the average amplifier and speaker.

If at the time these high frequency distortions occur there is a tone of lower frequency, intermodulation distortion will result, and part of the "tizziness" of recordings played with worn styli are, in fact, due to this intermodulation distortion.

With a "one thou" stylus, it used to be taken that the economic life of the stylus was terminated when the "flat" diameter was one thou. This is probably safe for domestic equipment, but in the light of present experience with modern high fidelity wide-range equipment (in which other distortions are being reduced to a very small value) the stylus "flat" should never be allowed to progress above 0.3 or 0.35 thou if the ultimate in reproduction is to be maintained.

From **fig 1** it is seen that this has been exceeded with a sapphire stylus playing at 5 grams at 10 hours' playing time. In the case of the diamond, it is also apparent that if this very desirable requirement is to be achieved for an economic length of time the playing weight of the cartridge must certainly be less than 5 grams.

PROBLEM MORE SEVERE

But, coming back to stereo, the problem is even more severe. Because, as we have said before, the geometric distortion of the record is greater than in the case of normal lateral recordings, the radius of the stylus must be reduced considerably, and another series of experiments was undertaken to determine the diameter of the "flat" versus playing weight and radius of the stylus. In addition to the normal one thou. stylus which is used almost universally for modern fine groove monaural recordings, two other values of radius have been proposed: one is half-thou. for stereo cartridges, and the other is 0.7 thou for cartridges to play both stereo and monaural records. (This latter value only allows the cartridge to be played at a slightly heavier playing weight than the half-thou—it does not, in any magical way, make the cartridge "compatible.")

It is seen that at 5 grams playing weight, even the diamond does not have a greatly extended life, and the half-thou diamond has a probable expectation of life of less than 50 playing hours when used in a 5 gram cartridge. Again, this is for a 0.35 thou "flat," and it is perhaps fortunate that the trade generally have tended to produce half-thou diamonds on the top limit rather than the bottom limit (i.e., the nominal half-thou diamond is nearer 0.65 thou rather than 0.40 thou in radius). But again, because of the inherent geometric distortions of two-channel disc stereo, the distortions due to "flat" size of the stylus have, up to date, passed unnoticed.

The reduction in stylus wear by reducing the playing weight from 5 grams to 2 grams is startling in the extreme. Where, with a half-thou point, 50 hours was found the maximum that should be expected for a 5 gram playing weight, reducing the playing weight to 2 grams gives a life expectancy considerably greater than 1,000 hours. This does not mean, of course, that the playing weight of any cartridge can be reduced to 2 grams. But it does give some idea of the enormous benefits to be obtained

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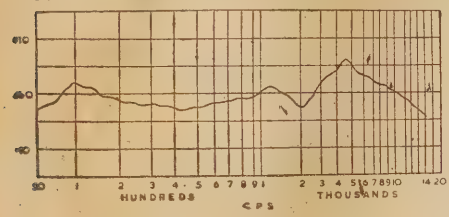

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when using a cartridge at this lower value of playing weight.

All the other problems associated with pickup bounce due to mechanical impulses being transmitted to the motorboard (when a person walks across the floor, etc.) have been carefully glossed over in this particular treatise.

To summarise our results: Firstly, the maximum "flat" which should ever be allowed on a stereo diamond is 0.35 thou, and with the majority of stereo cartridges at present available this gives a life expectancy of a few hours only. Secondly, the use of sapphires, especially at loadings of 7 grams even though of 0.7 thou in radius, is to be deprecated by all users of high fidelity equipment who have any regard whatever for their records. Finally, the price of present-day diamonds is high in comparison to other component costs in high fidelity systems.

DIAMOND PLANES

The diamond can only be sawn in particular directions, whilst in other directions it has planes of weakness, known as "cleavage" planes, in which if a sharp blow is applied to the stone in a direction parallel to the cleavage plane will result in the diamond splitting along that plane. The grinding or sawing planes are parallel to the cube faces **(fig. 4a)** whilst the cleaving planes are parallel to the octahedron faces **(fig. 4b)**. That is, the grinding faces are always square, whilst the cleaving faces are always triangular.

It is, therefore, important when selecting a stone for producing a stylus that it is correctly orientated regarding its various axes so that the cleavage planes are in a position to do least damage. For instance, if the stone were to be cut perpendicular to one of the octahedron faces, the cleavage plane would then be across the rondel diameter and if the stylus received a sharp knock the stylus would probably break squarely across its diameter.

Fig. 4c shows the diamond points produced today in relation to their axes. It is seen that the major length of the point is along the Z or optical axis, and the cleavage planes are approximately 60 degrees to this axis. This has another advantage in that the octahedron face is the hardest of all the various cuts and therefore, theoretically at any rate, should be the most wear resistant. The spherical tip is then ground over the conjunction of these faces and, to a large extent, the life of the diamond (and the record) depends on the degree of accuracy and the fineness of polish with which this spherical form is achieved.

As is well known, the diamond is one of the hardest materials known to man. We will now sketch a diamond crystal, but no attempt will be made to treat this matter from a mathematical point of view.

Crystallographically, the diamond is termed a "cubic" crystal. That is, it has three axes, each of which are perpendicular (90 deg.) to each other and all are of equal length (see **fig. 3**). The three axes, which are termed "X," "Y," and "Z" emerge from the centres of the six faces of the cube. Although the basic theoretical form of the diamond is cubic, this form of natural stone is relatively rare. The more common form of diamond is called the "octahedron" **(fig. 4a)** and is usually termed the "ideal" form.

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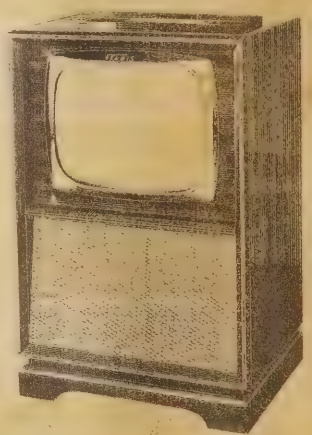

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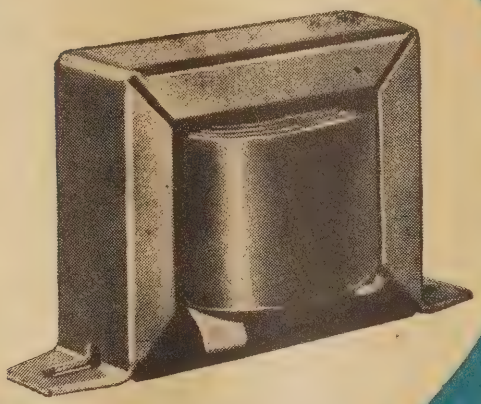

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TRANSISTORS ARE NOT VALVES

Because learning is a process of viewing the unfamiliar in terms of the familiar, it is natural to attempt to study transistors by comparing them to vacuum tubes and noting the similarities. Although some such similarities exist, the transistor differs from the vacuum tube in more respects than it resembles it.

FOR this reason, it is more fruitful to consider the differences rather than the similarities:

1. The relationship between bias and output current in a transistor is opposite that of a vacuum tube. In the vacuum tube, bias is a voltage applied between grid and cathode. Increasing the value of bias will result in a decrease of plate current. This is shown in Fig. 1A, where closing the switch would cause the meter pointer to swing down in the direction of the broken arrow. In a transistor, bias is a current which flows through the emitter-base circuit. Increasing the value of bias will result in an increase of collector current, as in Fig. 1B.

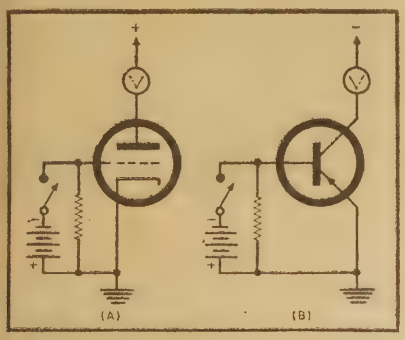

Fig.1—Closing switch to increase bias reduces plate current (broken arrow in A) but increases collector current (B).

2. Cut-off in a transistor is a condition of minimum, but not zero, collector current. When a vacuum tube is cut off (by increasing the bias sufficiently), the plate current is zero. (Fig. 4A.) When a transistor is cut off (by removing the bias), a small amount of current still flows in the collector circuit. (Fig. 4B.) The collector current which continues to flow when the emitter current is zero is known as the cut-off current, or Ico.

3. The transistor is a temperature-sensitive device. Within a wide range of temperatures, the performance of a vacuum tube remains relatively unaffected. A radio receiver employing vacuum tubes may work as well outdoors during an Alaskan winter as it does on a hot beach in July. The operation of a transistor, however, shows a much greater dependence on temperature. A temperature change of only a few degrees may be sufficient to prevent normal operation of a transistor circuit unless stabilising techniques are employed. Stabilisation circuits are necessary to prevent thermal runaway, since an increase of temperature will result in an increase of current, and and increase of current will result in a further increase of temperature, ad infinitum. See Fig. 5.

4. Incorrect polarity of collector voltage will damage the transistor. If the "B" supply of a vacuum tube is accidentally reversed, the circuit will be inoperative but the tube will not ordinarily be damaged. (Fig. 2A.) By contrast, the transistor will be ruined if voltage of improper polarity is applied to the collector. (Fig. 2B.) Under these conditions, the collector junction will be biased in the forward direction, excessive current will flow, and the junction will overheat. For proper operation of an n-p-n transistor, the collector should be operated at a positive potential. The p-n-p transistor requires a negative collector voltage.

5. The input impedance of a transistor is relatively low. The input impedance of a vacuum tube is high, particularly in circuits which do not draw grid current. For this reason, vacuum-tube circuits may be cascaded without introducing excessive loading of the preceding stage. This is shown in Fig. 3A, where the connection of the second vacuum tube drains off very little current from the first stage.

Cascading of transistor stages, however, presents a greater problem because the low input impedance of each stage tends to load the output circuit of the preceding stage, as in Fig. 3B. Adding the second transistor stage causes some current to flow from the first stage. Such loading has an adverse influence on gain and frequency response .

The exact numerical value of input impedance depends upon the type of transistor, parts values, and the type of

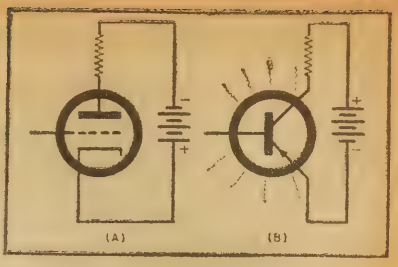

Fig. 2—If applied voltage polarity is wrong, a tube (A) will not function but a transistor (B) will be ruined.

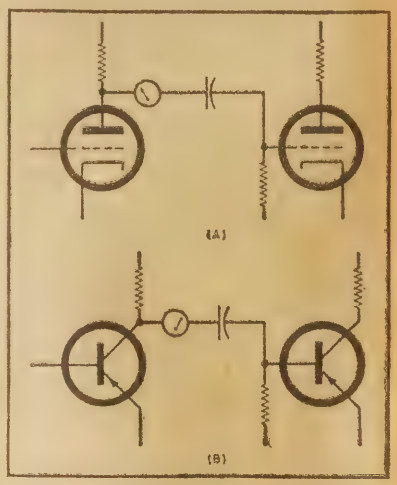

Fig. 3—(A) Tube at right drains little current from preceding stage. (B) Second transistor loads down one at left.

circuit connection. Grounded-collector stages have higher values of input impedance than grounded-emitter or grounded-base stages, but the voltage gain of the grounded-collector circuit is less than one.

Another consequence of the low input impedance of the transistor is that large values of coupling capacitance must be used to maintain adequate low-frequency response. Coupling capacitors from 2 to 50 ufd are not rare in transistor audio stages.

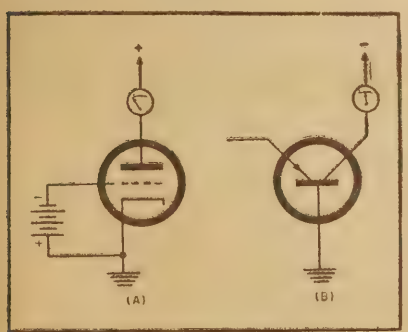

Fig. 4—Plate current is zero (A) in a cut-off tube. Some cut-off current flows (B) through a transistor's collector.

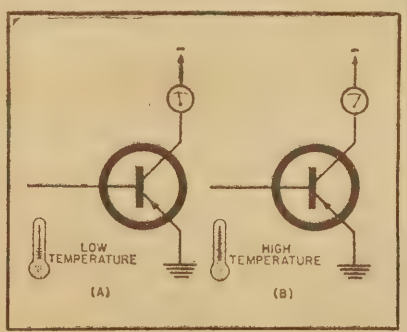

Fig. 5—The collector current of a transistor increases (see ammeters) as its temperature increases during warmup.

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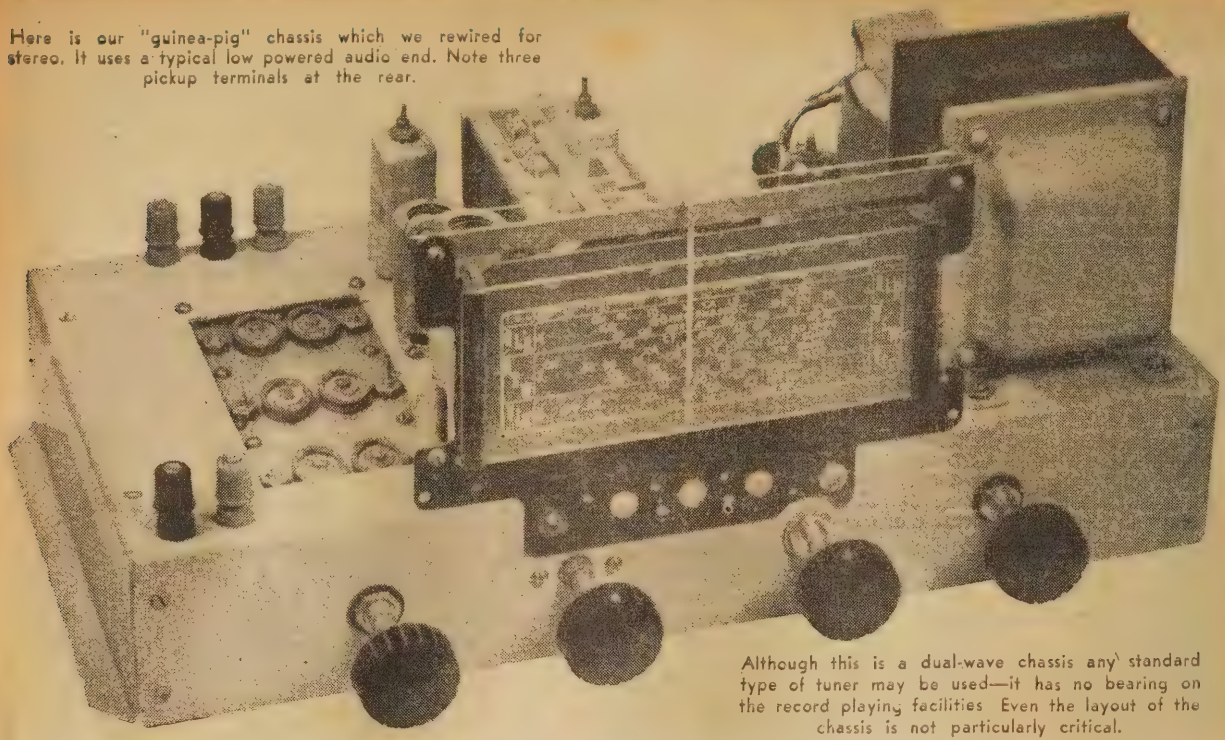
Here is our "guinea-pig" chassis which we rewired for stereo. It uses a typical low powered audio end. Note three pickup terminals at the rear.



Although this is a dual-wave chassis any standard type of tuner may be used—it has no bearing on the record playing facilities. Even the layout of the chassis is not particularly critical.

A matched, dual volume control must be used. Do not use a control with an AC switch or hum may result.

How To Convert Your Radiogram To Stereo

If you operate a standard type of radiogram you can convert to stereo by adding a simple audio amplifier speaker, with very little alteration to your original chassis. This article is intended to suggest how you may make the necessary changes, and the results are quite comparable with similar commercial designs now appearing on the market.

by John Moyle

THE stereo equipment we have described to date has been aimed at the man who we assume will take his stereo more seriously than the average, and is prepared therefore to spend more time and trouble to get results.

By this time many people must be quite convinced that stereo is not confined to expensive hi-fi, and it will be a good thing when everybody realises it.

Many must have been pleasantly surprised to find that some of the first stereo radiograms to appear cost very little more than the older style models in comparable qualities.

It's quite essential that a commercial type radiogram should require either one or more speaker cabinets and perhaps the additional amplifier unit, or else a single cabinet somewhat larger and more elaborate than before. One or two extra valves are involved, and none of these things can be added without spending more money.

But, even when listening to the modestly priced and medium quality machines, few listeners fail to appreciate the value they represent.

The addition of stereo will not alter the fact that some radiograms are better than others. Provided that reasonable care is taken to give both channels a chance, stereo of some kind is certain to be achieved and the net sound will certainly be better for it.

In our experience, even the simplest of equipment, of a type to be described in this article, sounds infinitely better in stereo than it does when played single channel.

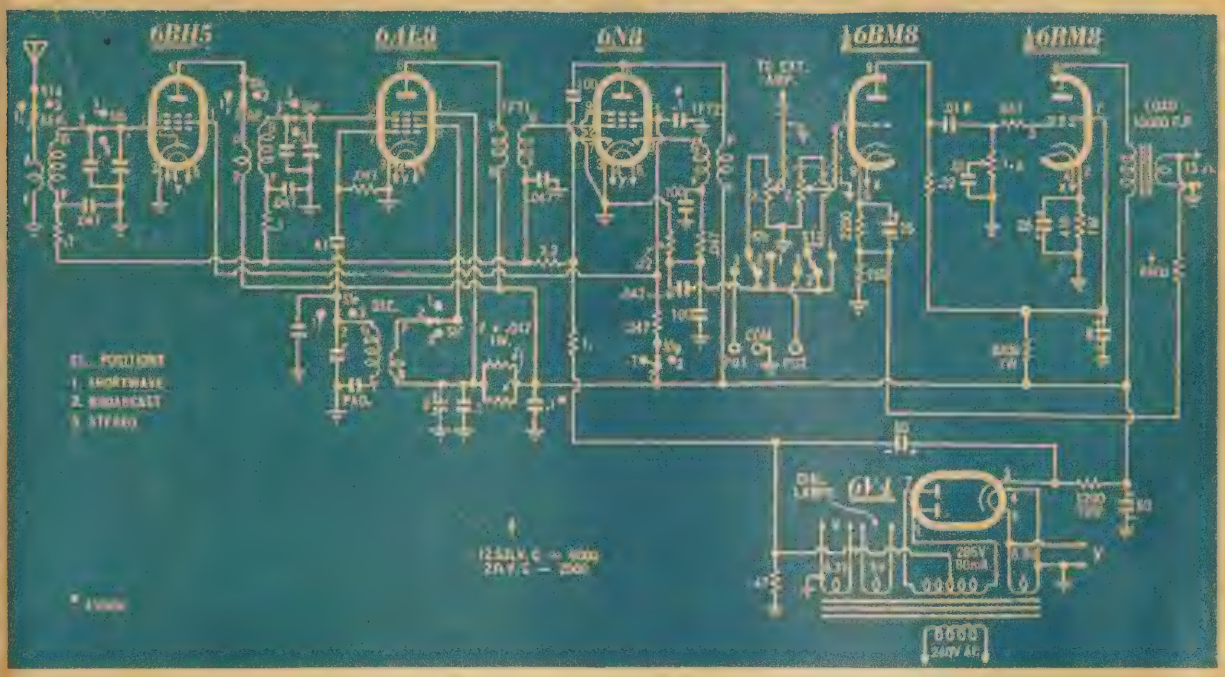
By questioning those who are hearing it for the first time, it is clear that the difference they hear is attributable to stereo and nothing else.

By that I mean that the circuits, power output, speaker quality and limits of distortion were the same in each case. The shortcomings of the equipment were there for stereo no less than for single channel, but they were not so apparent.

It is probable that, in the latter case, a great deal of emphasis is placed, consciously or unconsciously, on matters of frequency range, dynamic range, close and spectacular recording techniques, and distortion.

Preoccupation with these things was the only way to build the sense of reality and presence which stereo now gives us in one stroke. Immediately, our valuation of them undergoes a complete change. I do not mean that they are no longer significant. I mean that the widening of the sound source and combination of the stereo channels gives a new dimension so important that our

TYPICAL RADIOGRAM CIRCUIT RE-WIRED FOR STEREO



Here is the circuit of the receiver. The audio end may be combined with any type of tuner, and a more powerful amplifier section can be employed to give higher volume. In either case connections to switch and volume controls would remain the same.

previous basis of judgment is no longer completely valid.

It now seems that the stereo effect is even more accommodating than I at least was prepared to admit in the first instance. Unfortunately after handling playback equipment of high quality for long periods, and schooling oneself to reject even small imperfections, it is difficult to come down to earth and appreciate more modest results for what they really are.

It is quite true that to compromise in any way with the best standards will inevitably mean results which will in some degree fall short of the best. But it's equally true to say that those who have been and are satisfied with the modest standards of the average radiogram will be equally if not more satisfied with modest standards of stereo.

For instance we have been playing the equipment described here with a couple of loudspeakers which are badly matched, one being much more prominent in the essential middle register than the other.

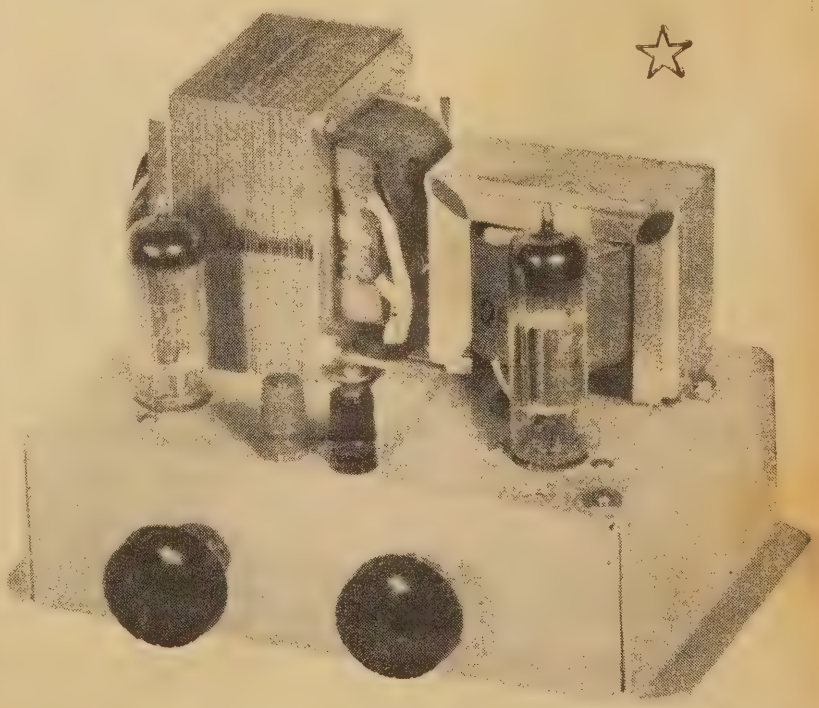
Even the inexperienced listener could tell the better and more accurate separation of program which took place when better balanced speakers were used, but that didn't prevent him from receiving some of the benefits of stereo even with those poorly matched.

Thus, while it's quite important to see to such things as good channel matching, it would be foolish to abandon the idea altogether just because it's not practicable at the moment to achieve perfection.

And it is only being realistic to admit that, if your natural status in the realm of quality is a pretty exacting one, you are likely to be just as exacting with your stereo.

As I have said many times, any stereo is good, but the best is magnificent.

Coming now to the practical part of the discussion, how should we answer the question which is becoming more



A front view of the amplifier unit for use with the receiver. The chassis which measures 6½ x 4½ x 2 inches can be used for any type of simple audio circuit. There is room for a third valve socket immediately behind the terminals. The 6AU6-6V6G circuit could be accommodated with ease. Volume/balance control on the left, tone control on the right. The input lead should be kept as short as possible.

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and more frequent — "How can I use stereo with my present radiogram without spending too much money? And if I do will it be worth while?"

To answer it, let us state briefly the requirements for stereo before we see how they can be met.

You are going to need a new stereo pick-up head fitted into a suitable arm and working with a motor which has as little vibration and rumble as possible. The pick-up will probably be of the crystal type because most radiograms use it, and it has the same advantages of simplicity, low cost and high output when made for stereo. In fact the difference in price between a crystal (or ceramic) cartridge and a magnetic or moving coil type is likely to be so great that only specialist users of high grade equipment will be interested, at least for a while.

EQUAL SENSITIVITY

The two channels of the pickup will come away in two shielded leads and must feed into equipment which has two complete channels of the same sensitivity for a given output. In other words if one gives 4 watts with an input of 200 millivolts, then the other should do the same. If one channel should have a higher maximum output than 4 watts, this won't matter as long as it will give 4 watts with 200 millivolts in. Its extra power handling just won't be needed.

Finally you will require two loudspeakers, preferably of the same make and type, for this is the best way to ensure that their characteristics will match.

The main requirement for balanced sound from the two channels is that the volume from each, when playing program of equal strength, should be the same. Therefore we'll need some simple means of balancing them up in the first place, and preferably a volume control with two sections, one for each channel, so made that it will increase or decrease volume equally in each case.

That will do for a first statement of the problem. We will mention further points of detail as we go along, but, in general, this is what we want for good stereo.

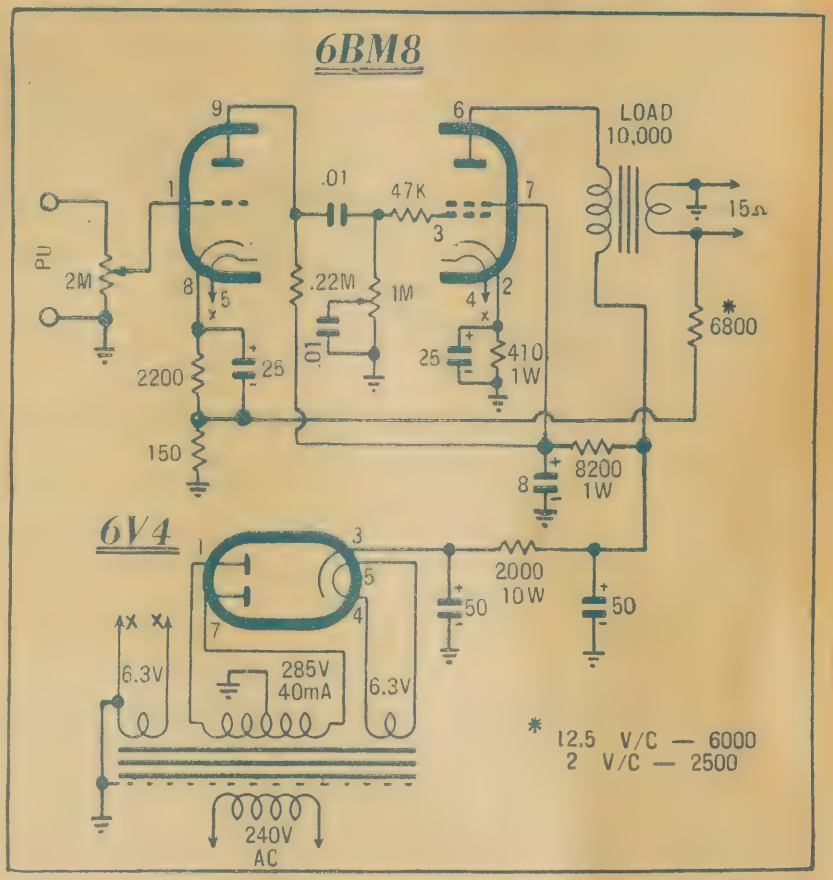
PICKUP CARTRIDGE

Reverting to pick-ups, there are cartridges now available which will fit into the standard arm mountings, either directly or with an extra bracket, and in many cases you will find these will not present a problem. If you are unlucky enough to have an arm which will only take one special cartridge, and no ingenuity will allow a stereo fitment, then a new arm looks to be the only solution. Because stereo calls for a more rigid standard of quality in bearings and freedom of movement, it's wise to spend a few pounds on a good arm, for by so doing you will have better control over stylus pressure, less record wear, and less trouble with alignment.

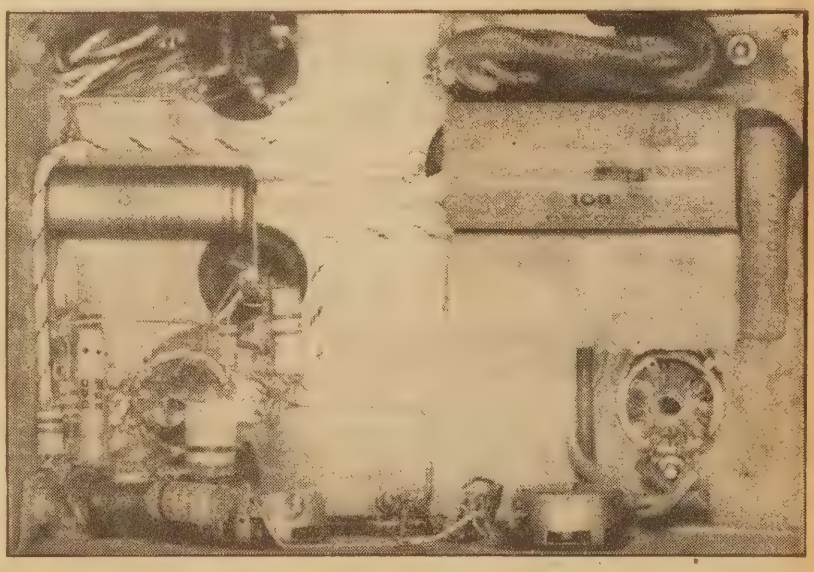
Great care should be taken to see that the pickup is correctly aligned and that the stylus sits squarely in the groove. Pressure should not be more than 4 or 5 grams, preferably less, to avoid rapid deterioration of both stylus and records.

You can get cartridges either with a single stylus, which will play stereo and most recent single channel recordings

CIRCUIT OF SIMPLE STEREO UNIT

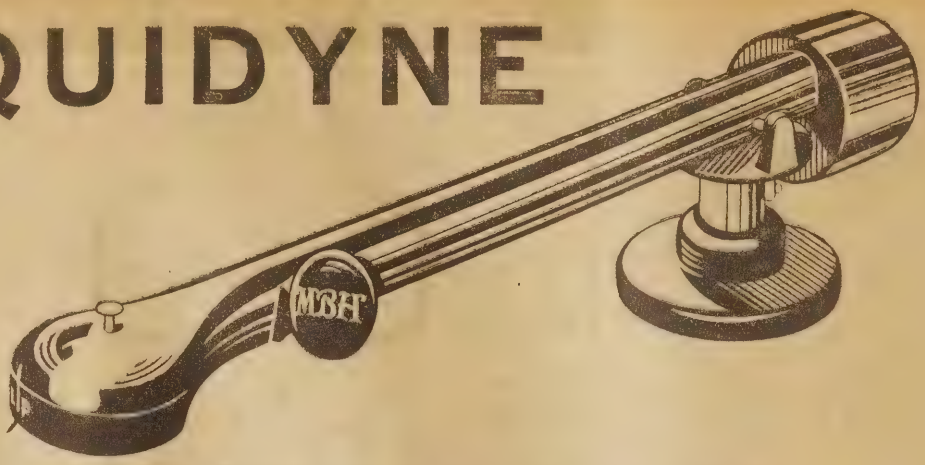


The circuit of the extra unit using the 6BM8 valve. This unit has slightly less feedback than the set in order to give it some extra sensitivity for balancing purposes. Voltage between pentode plate and chassis should be 266 volts, and between screen and chassis 216 volts. Maximum output will vary between about 2.5 and 3 watts depending on the quality of the output transformer.



Signal components are mostly grouped around the 6BM8 valve socket. Keep grid and plate leads of the triode section well away from those of the pentode to avoid instability. Filter components for power supply are at bottom left. Note vacant area in the centre of the chassis where another valve socket can be mounted.

EQUIDYNE



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SET NEEDS DUAL VOLUME CONTROL

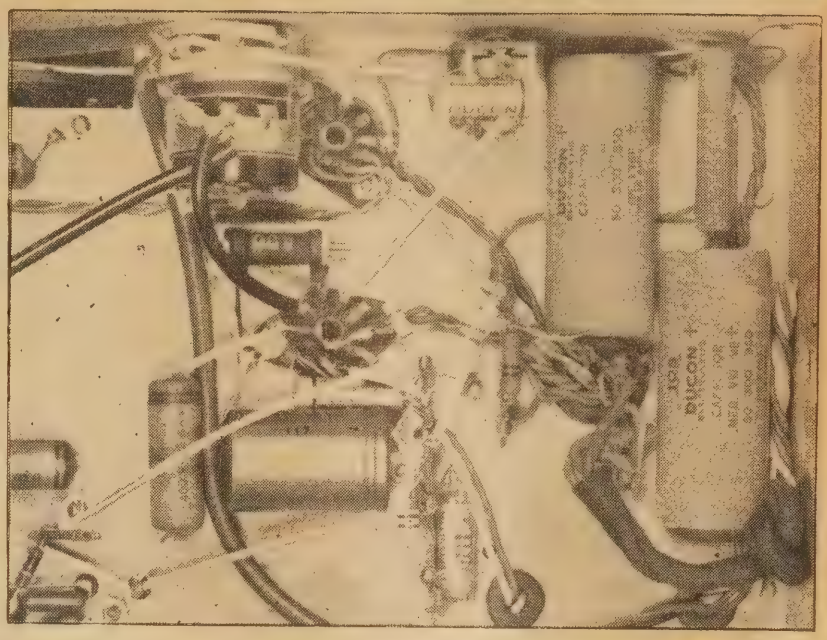
without change, or you can get turnovers if you are still interested in 78's. Most can be had with either sapphire or diamond stylus but, if you play many records, the diamond will avoid frequent stylus replacement which is often hard on pick-ups and is a great nuisance. You can possibly start with a sapphire and replace with a diamond—your preference and pocket will decide. Some cartridges have four terminals instead of three to allow complete separation of leads, but in general the three-terminal type are quite OK because the two earthed connections will probably join up sooner or later. For the moment we don't want to make a complication out of this point.

You can run new leads, shielded right up to the pick-up head, using fine, shielded wire now available from most stores. Take care when soldering to avoid melting the plastic insulation and shorting the inner wire to the shield. If you hold the lead in long-nosed pliers while soldering you can avoid the heat running back along the wires.

GOOD MOTOR NEEDED

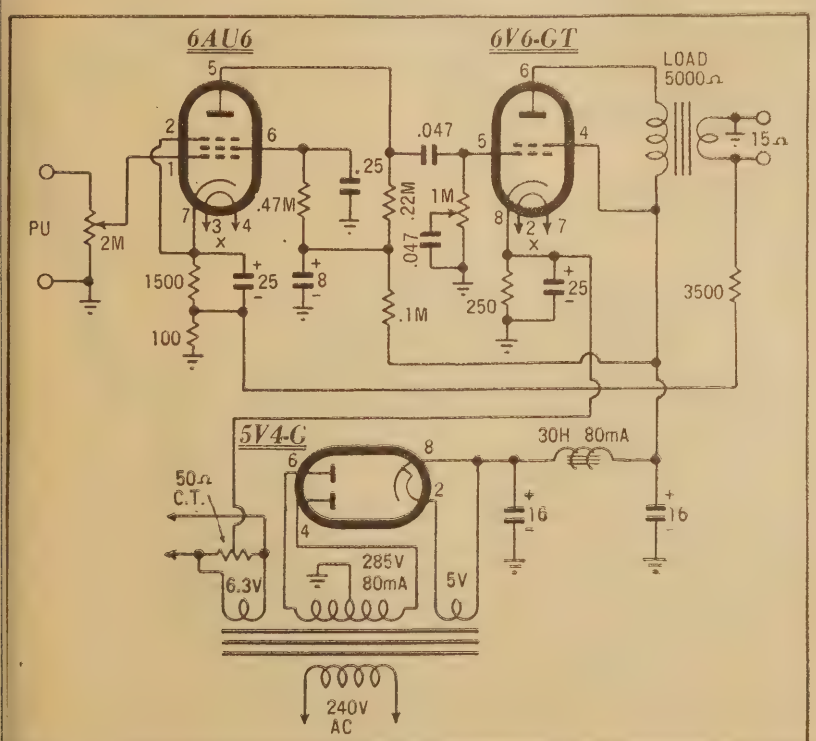
Unfortunately, most of the cheaper motors have appreciable vibration, and because the stereo head will respond to vertical as well as to lateral movement, any rumble will be accentuated. If your motor isn't a good one, that's a pity, although by inserting a wire-wound resistor (10 or 20 watts) in series with one AC lead to reduce the voltage to about 200, a big improvement can often be made without reducing the torque too much. For the moment, that's the only suggestion we can make.

Record changers are rather harder—some will work OK and others not so well. Because they need a minimum stylus pressure to work the trip mechanism they give designers some trouble.



Portion of the receiver underchassis showing a dual volume control. The switch section is not used. If you want an AC switch on the controls include it with the tone control. The gramophone change-over switch in this case was attached to a dual-wave bracket wave-change switch. All pickup leads should be shielded and kept well away from any AC wiring.

Further experience is necessary to make more worthwhile comment than this. Obviously, a well-made, smooth-operating changer will be better than a cheap or barely satisfactory unit.



Here is a typical 2-valve audio amplifier as found in many receivers and which is quite suitable for the unit as well. Output valves of this type will provide a little over 4 watts which, with 2 channels, is more than adequate for ordinary listening.

If you must buy a new player unit, there are several stereo types available and, as in the case of an old style player, quality varies with price. We have tested two or three and they seem OK. Stereo hasn't altered the pros and cons about players except that obviously it's harder to make a good one than for single channel work.

In order to clarify the position with an example, we have tackled the matter of the playback equipment by taking an example from real life.

Some little time ago, we described a radiogram using a pair of 6BM8 valves in push-pull, and even designed a cabinet to go with it, complete with a baffled speaker enclosure, which was very popular.

It looked to be a useful design to convert to stereo, because, in so doing, we could illustrate many points which will help those who intend to do the same.

AUDIO CIRCUIT

As far as the audio channel is concerned, it would have been quite practicable to have duplicated that already used in the set, and build a second unit also using two 6BM8's. If you wish to do this, you can merely employ the input connections now to be described to such a unit, duplicating the power supply, output transformer, etc., a task well within the ability of anyone who made the original unit.

But probably the majority of radiograms are in reality radio receivers with a single output valve and a pick-up connection, which can be switched in and out at will.

So we rewired our original receiver so that the audio end used a single 6BM8, and we used the second valve for the additional unit.

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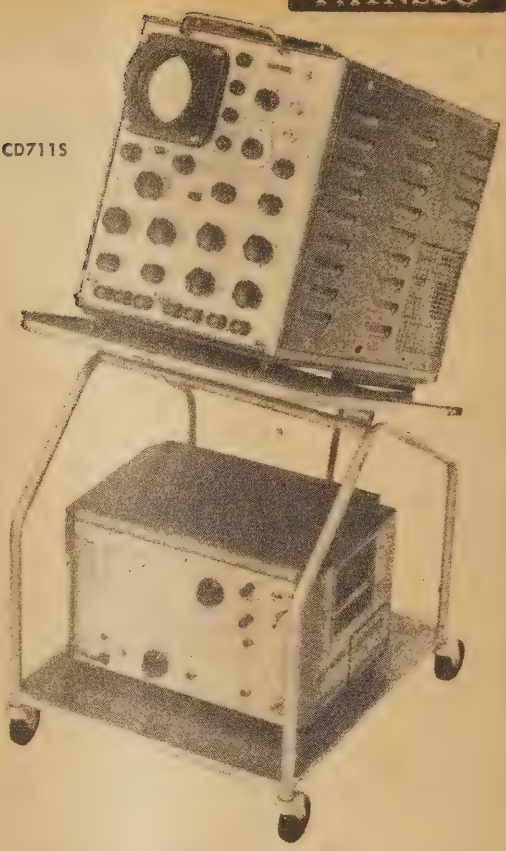

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Not all such radiograms will use the 6BM8. In fact, it's almost a certainty that most of them will use something similar to another circuit reproduced here, which has a 6AU6 driving a 6V6G in a straightforward connection.

This circuit was originally used for an early Playmaster, and if your present set has a similar circuit, it would be the one to use. Its input for full output is 200 millivolts, quite typical of the audio end found in many radiograms.

By scanning through the diagrams given here, you should have no trouble in accommodating variations to suit other valves which might have been used originally, varying such things as bias resistors and using output transformers of the correct impedance.

The purpose of this article is not to make specific recommendations one way or another, but to examine the requirements in a general way so that you can adapt our suggestions to suit your own case.

USE OF 6BM8

However, the 6BM8 is a useful valve, and is used freely today in audio circuits because it combines a high gain triode in the same amplifier as an economical output valve, which will give just over 3 watts at the secondary of a high quality output transformer.

Two such amplifiers will give enough volume for the average room which previously has been satisfied with an output of the same order.

In practice, of course, the two channels will do considerably better than one, and this type of circuit is bound to be used quite freely in medium-priced commercial designs.

Coming now to the receiver, the first provision had to be a dual volume control of a type now being made for stereo.

Both potentiometers are connected to a common shaft, and are matched so that their rotation corresponds throughout its movement to within a few db. You might have to order these components for a while, until the demand allows them to be kept more freely in stock.

There should be no difficulty in fitting this control to the average chassis, and at the worst you can move an odd component which might be in the way. Either standard or miniature sizes can be obtained.

MAINS SWITCH

Do not use one which incorporates a mains switch, for, as the pick-up needs a high value as its load, there is danger of hum pickup if you do. Move the switch to the tone control if you must use one.

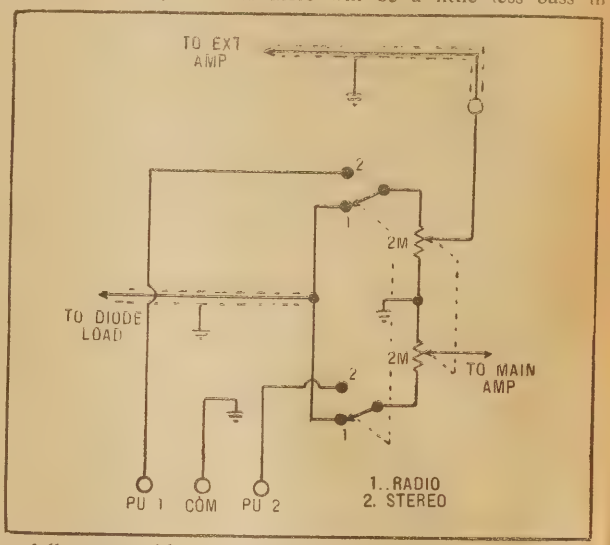
There is nothing remarkable about the wiring of the 6BM8. Because this valve was not originally intended for audio, typical operating conditions when used as a dual audio valve have been subject to various private designs, including some of our own. In order to preserve some consistency, we referred the matter to Mullard application engineers, who have supplied a set of operating conditions which were developed for some stereo circuits they intend to make available.

These have been developed to give the highest output consistent with lowest distortion, and correspond very closely with some independent work of our own.

The feedback on the receiver channel was set to about 12 db, which is enough to be useful, and allows full output with about 200 millivolts input, well within the capabalities of a stereo pick-up on the average record.

Several transformer manufacturers have developed output transformers of various grades to suit these conditions, and these should be available when this issue appears in print.

The circuit provides just over 3 watts before clipping occurs, and at 2.5 watts the distortion is claimed to be quite low for this type of circuit. Two such channels fill the average room very nicely



This diagram shows the comparatively simple method of switching the pick-up from radio to gramophone. The two amplifiers are in parallel when listen-to radio.

This modest amount means that medium quality transformers can be used with little risk of instability. If you take care to keep input and output leads and components well separated, you should not have any trouble of this kind.

The inputs from the pick-up come into the chassis through terminals placed in a clear and convenient spot, one to each section of the volume control. If there is any switching for pick-up, this must be arranged so that the radio tuner feeds both amplifier channels, and a suggested circuit is included herewith. There isn't much point in confining the radio to one channel, although there is no objection if you want it that way, except that the total output available will be less.

The second channel is built on a separate chassis, and should be a duplicate of the first. Its input comes directly from the volume control through a shielded lead, which should be kept as short as possible.

A long lead, because of its capacitive shunt across the pick-up, will reduce the input voltage to the channel, and you may have difficulty in balancing the two without removing some of the feedback from it to make up for lost gain.

BALANCE CONTROL

Ideally this unit should have a little more gain than its partner and we have already arranged for this by a small reduction in feedback. There is a separate volume control fitted for balancing purposes, but in most cases it will be adjusted to almost the full on position.

The best position for it would be inside the cabinet somewhere near the chassis of the set. It is possible to include it in the enclosure which houses the second speaker, and we have been successful with a connecting length of co-axial cable 12ft long. This practice is followed by some manufacturers who desire to produce self-contained stereo extensions, but it is best to avoid the loss which the long cable must introduce.

Obviously, the second volume control, being almost completely in parallel with the first, will reduce the total load on the pick-up to almost 1 megohm, and thus there will be a little less bass in the second channel than in the first.

In practice this isn't very important, for the stereo effect is less dependent on bass than on the middle register, which will not be affected. If you are fussy you could wire an additional 2 meg resistor across the other pick-up input to balance things up, but it's hardly worth while, as the two pick-up sections may not be exactly the same in this respect in the first place.

Both channels have tone controls to reduce the highs if this should be necessary. It isn't a very good method of using such a control, as it is within the feedback loop, but it works, and can be accepted in a circuit where the feedback is not very large in the first place.

Mostly you won't have to use it.

SIMPLE POWER SUPPLY

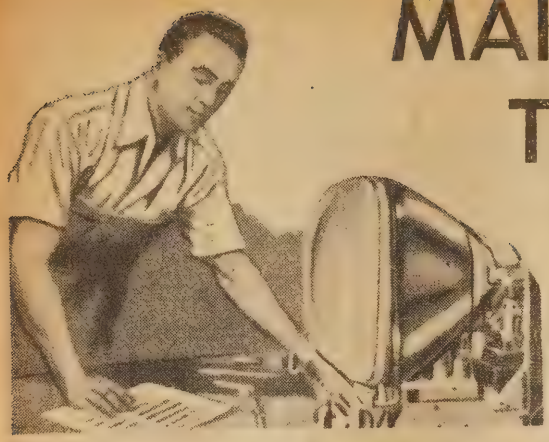
The power supply for the unit amplifier is very simple and is virtually hum-free. The voltage between the output plate and chassis should be 266 volts, and by using a 285-volt transformer and large filter capacitors we can use a smoothing resistor in place of a choke which also reduces the voltage at the rectifier to the required amount. The screen voltage should be 216 volts, and we have used this feed point for the plate of the triode section. An 8 mfd bypass capacitor at this point serves to "earth" the screen and decouple the triode.

There is no need to change the power supply circuit in your set, as long as the voltage available for the 6BM8 does not exceed the figures given. As this is much the same as that for any typical output valve, you should not be troubled.

If you use the power circuit of the unit, the value of the filter resistor should be reduced to allow for the extra drain of the tuner.

In our case we ignored the extra current rating of the power transformer, although it would have been possible and permissible to have used it to power both amplifiers. However, we intended

(Continued on Page 111)



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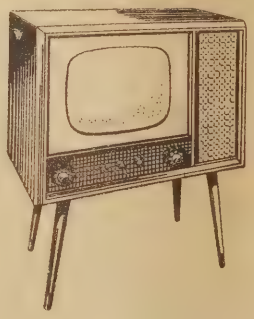

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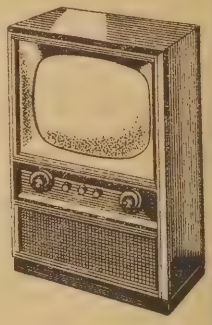

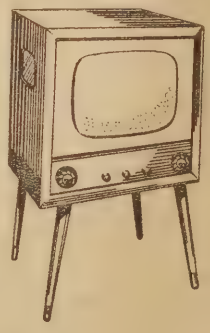

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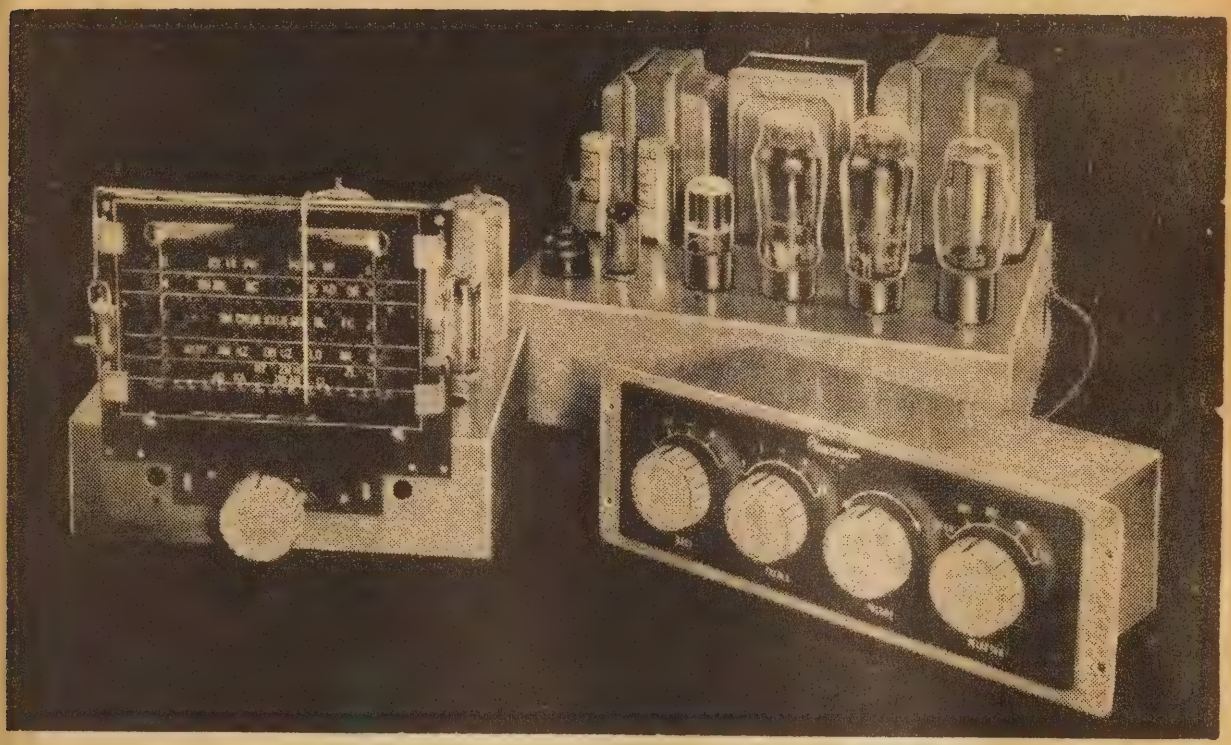

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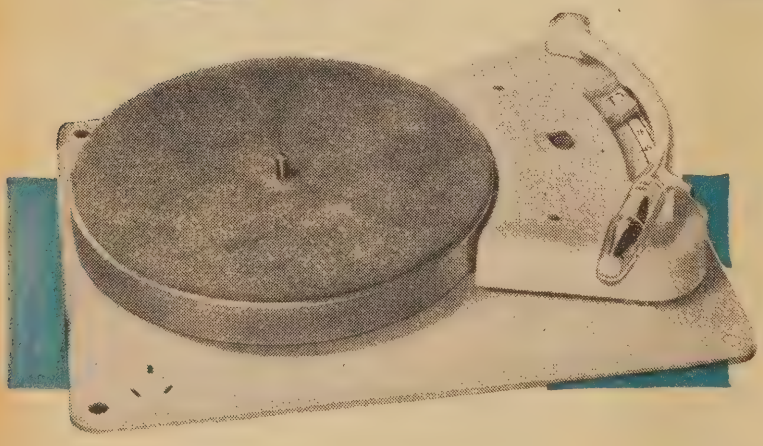

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P655-58A

Here's your answer, Tom!

The queries this month are from two readers. One is having difficulty in understanding the behaviour of vibrator supplies and line output supplies, while the other is apparently trying to design or modify a battery receiver. With the exception of the line output EHT supplies, the queries have appeared in the past under one guise or another. However, we feel them sufficiently interesting to publish as an example of the problems met with by two individuals in the pursuit of this fascinating hobby.

I have been reading your magazine for a long time and in its pages I have seen numerous vibrator power supplies and in the later issues a number of line output EHT supplies. What puzzles me, is why a rectifier is necessary. Taking the vibrator supply first, the vibrator merely stops or allows the current to flow. In other words the output is pulsating DC. Surely if this were rectified all or none of the current would pass. The same thing applies to the line output EHT supplies. Saw-tooth waves are either all negative or all positive and thus if one tried to rectify them, either all or none of the current would flow. I am sure that my reasoning must be wrong somewhere, but I cannot for the life of me see where.

Your assumption that the vibrator merely interrupts the flow of current is quite correct. However, you have overlooked the remaining circuit components and their behaviour.

As you will note on looking at a typical circuit, the vibrator is connected to a transformer. In the case of a non-synchronous one, each of the contacts on either side of the reed is connected to each end of the primary. Their role is to interrupt the flow of current through the primary. The centre tap on the transformer is connected to the battery terminal opposite that to which the reed is connected.

In the normal position the vibrating reed is at rest. When the circuit is closed, current flows through the energising coil, attracting the reed toward one of the contacts. When these close, they short-circuit the energising coil, and allow the reed to swing back. The momentum of the swing carries the reed to the second contact with which it makes connection.

Now, as the reed connects with the first contact, it cuts the flow of current through the energising coil and instead causes it to flow through one half of the transformer primary. But this condition lasts only an instant and, on the return swing, the reed connects with contact No. 2, and causes current to flow in the opposite half of the primary.

Because the reed is constantly vibrating back and forth between the contacts, it is continuously causing the current to flow first through one half of the primary and an instant later through the other half, the action being repeated at a very rapid rate, usually at 100 cps.

As a result of this an alternating magnetic field is set up in the core of the transformer, inducing an alternating voltage in the secondary winding, just as in any other mains transformer.

By winding the transformer with many more turns on the secondary than on the primary, it is possible to step up the original six volts to any desired figure, usually between 150 and 300 volts.

The voltage available at the secondary, despite its unusual waveform (near square wave) is alternating and must be rectified in the normal manner. The rectified output will be a pulsating DC and will require filtering to smooth it to a steady DC.

However, a rectifier is not always essential, for a vibrator which also rectifies the secondary voltage may be used.

This type of vibrator is called a synchronous type and is equipped with an additional pair of contacts used to switch connections to the transformer secondary in synchronisation with those which switch the primary circuit.

The idea is that, as the voltage alternates, each end of the secondary winding becomes, alternately the positive and negative point of the circuit. If the reed is made to earth the ends of the winding when they are at a negative potential, the remainder of the winding including the centre tap must be positive.

It follows that if the respective ends are always earthed as they become negative, the centre tap must always remain positive. And, in fact, this is the point from which a rectified positive voltage is taken.

Likewise, in the line output and EHT supply circuits in a TV set, you have overlooked the line output transformer.

At the plate of the line output tube we have the usual DC supply voltage upon which is superimposed an AC component, much in the same manner as in an ordinary output stage. It is this AC component which is used to drive the deflection coils in the yoke as well as supply the EHT for the ultor of the picture tube.

The line output valve is operating as a class C amplifier and delivers its output in bursts, hence the irregular waveform. But this waveform is only positive if taken with reference to chassis.

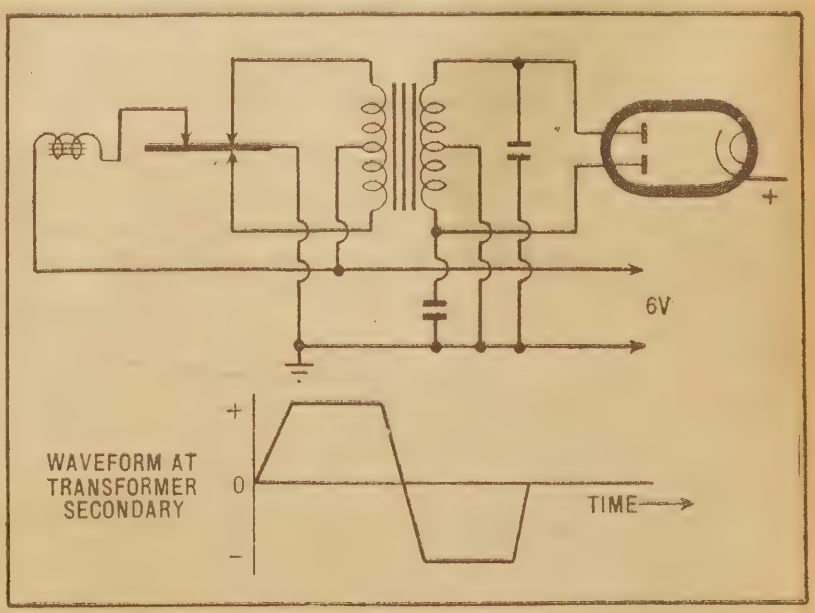

Diagram of typical vibrator supply as discussed in the text

Simon Gray Pty. Ltd.

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To: Advertising Manager

8th January, 1959

Re: March Ads for Radio, Television & Hobbies

This month I'd like to try something different in our advertising. Perhaps we could tell people that we have selected the world's finest audio equipment for national distribution in Australia.

Anyone who knows anything about sound recording and reproduction will agree that the products of LEAK, WHARFEDALE, NEUMANN, ORTOFON, TANDBERG, GRAMPIAN, etc., represent the highest standards obtainable anywhere.

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People in the trade are well acquainted with these features of our business. But maybe we should tell the other readers of "Radio, TV & Hobbies." What do you think?

Yours truly,

W. Gray

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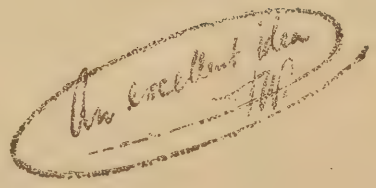


With reference to the anode, it consists of negative and positive going excursions which constitute an alternating voltage.

To derive the EHT, this AC deflection is stepped up in the line output transformer, which is wound as an autotransformer. The waveform at the EHT rectifier plate is only an enlarged version of the AC deflection voltage and must be rectified. After rectification it is filtered, but due to the high frequency employed, the filtering does not need to be elaborate, using very low values of capacitance.

A glance at some of the typical waveforms found in the above mentioned circuits should enable you to understand what we have discussed.

At (a) we have the voltage waveform at the plate of the line output valve, (b) represents the waveform at the plate of the EHT rectifier while (c) shows the filtered output at the filament of the rectifier.

Can a television aerial be used as a transmitting aerial? The aerial I have in mind is your Fan aerial having six elements and two low and high band reflectors.

You could use the fan as a transmitting aerial but it would not be ideal. It would be much better to use an aerial with a narrower band width and higher gain. However, many of the ideas and metalwork developed for TV aerials could be put to use by amateurs on the VHF bands. Unfortunately, the elements are rather costly as compared with many arrangements which amateurs can devise.

In any case the element lengths would need to be selected to suit the transmitting frequency.

Looking at a typical circuit of an IF amplifier stage, the lead G on the IF transformer is connected directly to the grid while F goes to earth or the AVC line. Does not the IF amplifier also function as a detector and would not the audio intelligence be present in the primary of the following IF transformer if it were tuned to reject the normal frequency? Could this method of detection be used instead of diode detection?

The answer to your query, Tom, is no. However, we shall qualify that.

Rectification in the IF stage would only be possible if the valve were operating on the non-linear portion of its grid bias/plate current curve. However, the operating voltages are selected so that the valve functions as a normal amplifier, the AVC being merely to control its sensitivity and prevent overloading on strong signals. Rectification would take place if an abnormally high input signal were applied to the input grid, but this state does not occur in normal use.

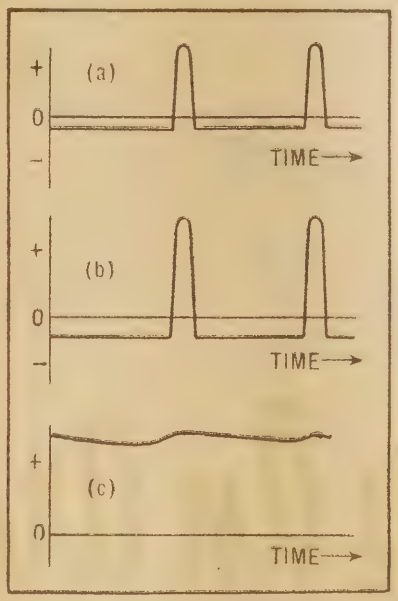
The signal available at the primary of the second transformer is still at the intermediate frequency, modulated by the audio signal. Should you detune the IF transformer the audio content of this frequency would be rejected as well. Even if it were possible to separate the IF and audio signals in this manner, no audio would be available at the secondary for the IF transformer will not work at audio frequencies.

In the data book the tube type 1P5 requires zero grid bias. Is it possible to apply AVC to this valve?

Many battery valves operate with zero grid bias and, where parallel connected filaments are used the application of AVC presents no problems. Simple AVC only is used, because only one diode is available, and it is applied in the normal manner through a decoupling network.

For zero grid bias is the grid connected to earth through a resistor or is there no direct connection between grid and earth? If the former is correct, would the value of resistance be critical in determining the input capacitance and would the resistance be critical in any other way?

The 1P5 valve is an RF amplifier and



Waveforms associated with the line output valve of a TV receiver.

is generally used as such. It is also quite suitable as an IF amplifier. In both these cases, the grid of the valve is fed through the winding of an interstage coupling transformer, either IF or RF.

Whatever its application, a DC grid return must be provided. This may be direct or through one or more resistors as in the case of an AVC network. Any assumption that an open grid is required for a zero grid bias condition would be incorrect.

The value of the resistance in the grid return circuit would have no direct bearing on the input capacitance. This is decided by the valve characteristics and the stray capacitance of the input circuits, which is naturally kept as low as is practicable.

From the valve data book I find that the grid bias for a 1C7 converter valve is minus 3 volts. Is this voltage obtained by the use of a resistor and capacitor in the cathode circuitry?

The bias for the 1C7 may be obtained from a separate bias battery, if one is used, from a back bias resistor wired into the power supply, or by earthing the grid return to the appropriate point on the filament chain, if the combination of valves should make this possible. Because there is no cathode as in an AC valve it is not practicable to use the cathode bias method as it is generally understood.

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Let's Buy An Argument

Who started all this business about Contra-Polar Energy and Contra-Terrene Matter? Back from holidays, ready to philosophise about ra dio in general, I found my desk piled high (metaphorically speaking) with letters on this mysterious subject and spiced, for good measure, with one or two on the "Vortexion" theory.

THE original letter on Contra-Polar Energy was published without much repercussion but my somewhat light-hearted response, in the January issue, to a further letter by A. W. met with a very different reception.

The excerpts on the opposite page are a fair sample. I suggest that you read them before proceeding further.

AT ORDINARY TIMES

Now one may be able to face such a barrage at ordinary times but certainly not on the first day back from annual leave, spent among the rolling hills.

With a sense of desperation, therefore, I grabbed the phone and rang a gentleman well known in the field of atomic physics.

"Please tell me," I pleaded, "the facts about Contra-Polar Energy."

"What . . . !"

Printing cannot convey the expression of amazement in this one word, nor the eloquence of the pause which followed.

He was speechless, bewildered; stumped by my question.

I tried again.

"Well then, what about Contra-Terrene Matter?"

His second "What . . ." and pause completely overshadowed the first. Then, in measured tones, he said . . .

"Please spell it."

I did so. Another pause. I couldn't stand it any longer.

In a torrent of pent-up emotion (heart-rending isn't it?) I told him the whole story of the reader from Singapore with his black light and cold heat; of A.W.'s patient explanation; of my own light-hearted rejoinder and then of this confidence-shattering bunch of letters on the table.

"Please tell me," I asked, "where fact ends and fancy begins."

by Neville Williams

Being relatively uninformed in this field, it would be presumptuous of me to attempt any kind of treatise on the strength of a telephone conversation but I did manage to clarify and confirm certain points.

I imagine that their recitation will pacify most of my correspondents but not those who persist in talking about vortices and so on. I have gained the impression that there is so much philosophy and theology bound up with Vortexion theories, that they are out of place in the pages of this magazine.

(Why can't I keep my big mouth shut?)

Be that as it may, the said points may be set out as follows:

BASIC FACTS

(1) Positive electrons were predicted in 1928 by Dirac and identified in 1932 by Anderson. They are known as "positrons." In my technical dictionary positron is defined as "the positive electron, discovered by Anderson. The mass and charge are of the same magnitude as for the electron but the charge is opposite."

"Modern Physics" explains that, in special circumstances, X-ray photons can be transformed into mass "pairs," an electron and a positron. By adding the energy necessary to produce a "pair" to the kinetic energy of the pair after transformation, the energy of the original photon can be deduced.

(2) Positrons have an extremely short life and almost immediately on occurrence they combine with an electron. Both disappear, their mass being transformed into energy to produce what is called "annihilation radiation." The life of a positron is of the order of one thousand-millionth part of a second while the energy involved in the annihilation or conversely the formation of a positron-electron pair is approximately 1.022 mev.

NEGATIVE PROTONS ALSO

(3) Negative protons have likewise been predicted for some time and have just recently been identified. Like positrons, they cannot exist for any significant length of time.

(4) Since positive electrons and negative protons are "annihilated" 'or transformed into energy as quickly as they appear, there is no opportunity for them to combine into chemical atoms in any conceivable terrestrial environment

MORE—AND MORE—ABOUT "CONTRA TERRENE" MATTER

PUTTING THINGS STRAIGHT

Dear Sir,

I read with interest A.W.'s letter of January and your comments regarding his "Contra - Terrene Matter" and, although I agree with you that A.W. was having his leg pulled, I feel that I must set things straight regarding this controversial substance.

The existence of a corresponding "anti-particle" for every ordinary elementary particle of physics (i.e. electrons, protons, etc.) has been proved both in theory by the dual solution of Dirac's wave equation and also, in several cases, by practical observation of their effect in cosmic rays and high energy particle accelerator beams.

The anti-particles are the same as their normal counterparts in all but one respect, namely, that their charge (if any) is of opposite polarity. When an anti-particle meets one of its corresponding "normal" particles, the two annihilate each other with a release of energy equivalent to their total mass.

By observing the annihilation phenomena, the existence of the anti-electron (positron) and the anti-proton has been definitely established.

Due to the fact that these particles are exactly the same as our ordinary particles, several scientists have postulated that it might be possible to have a whole galactic system made up of anti-matter. In it, an atom of hydrogen would consist of an anti-proton nucleus and a positron. If such a galaxy did exist, we would have no means of knowing that it was made of anti-matter.

Now on to A.W.'s letter, in which he stated that a proton-anti-proton annihilation yielded energy fifty million times as great as the fusion of a uranium nucleus. This time it is A.W. who has been reading too many American magazines.

Reference to any textbook on nuclear physics shows that the fission of U235 yields approximately 198 mcv. I am no mathematician, being only a 15-year-old schoolboy, but I easily substituted in Einstein's mass-energy equation and found that the energy produced by A.W.'s annihilation is approximately 1873.2 mcv, which is only 9.462 times that of uranium fission.

Yours Faithfully, G.H.

LEFT "WIDE OPEN"

Dear Sir,

As you remarked at the end of "Let's Buy An Argument" in "Radio, TV and Hobbies" of January, 1959, you have left yourself wide open.

On reading your remarks about "Contra-Polar Energy", my mind went back to articles which I had read, referring to the matter dealt with by A.W. — i.e. the question posed by the high altitude photographic plates. Unfortunately, I could not locate these articles.

However, don't start smiling too early because a few days later I opened my December, 1958, copy of "Science Digest" (an American magazine which deals in a popular way with many scientific happenings of the past and present) and in it was a brief article dealing with a projected investigation by the University of Chicago into high altitude cosmic rays and anti-matter.

As A.W. says, evidence of photographic plates shows a collision between two particles resulting in a gigantic release of energy. There appears to be two ways in which this could be explained:

(1) One particle was travelling at a speed many times that of light;

(2) One particle was a reverse type of matter to the other and, when they met, their mass was completely converted to energy.

Future studies may confirm the former but I would not be brave enough to say that the latter only happens on April 1st.

In conclusion, to provoke more discussion, I understand that investigation is being carried out into the nature of the mutual attraction between bodies (i.e. gravity) to see if a form of negative gravity can be produced.

If it can be produced, imagine the effect this will have on the possibilities of space travel.

Yours Faithfully, P.B.T.

IT DOES EXIST!

Dear Sir,

A recent correspondent to "Let's Buy An Argument" referred to "Contra-Terrene Matter". I wish to support his statement that such matter can exist.

The existence of anti-matter or contra-terrene matter was postulated as a result of theoretical considerations. In 1932 the positron was isolated. This is a particle of mass equal to the electron but it carries a positive charge. On encountering an electron, both particles are annihilated with a corresponding release of energy.

Similarly the anti-proton (having the same mass as but of opposite charge to the proton) and the anti-neutron were later isolated. These have the same property of annihilating the proton and neutron respectively.

Since these particles must encounter their counterparts sooner or later, they cannot exist for any length of time. However, in the absence of the electron, proton and neutron, these particles are stable and anti-matter may be built up from them just as normal matter is built up from the proton, neutron and electron.

Conceivably, the universe may contain regions where anti-matter is the rule and terrestrial matter is therefore incapable of natural existence.

I trust that the foregoing has helped to clarify the situation and perhaps even to whet your appetite for further knowledge in the field. Among recent developments in atomic theory is the explanation of electric and magnetic fields in terms of further fundamental particles.

Yours Faithfully, G.H.R.

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hich is completely dominated by nega-ve electrons and positive protons.

(5) The term "anti-matter" is com-nonly used to describe substances hich might conceivably be formed rom the union of positive electrons and egative protons. For reasons stated bove, the existence or feasibility of anti-natter is highly doubtful in any ter-estrial environment.

(6) The natural existence of anti-mat-er in space or in other celestial en-ironments is pure speculation.

Perhaps the foregoing may help to ationalise our thinking about the cor-espondence we have received on this eneral subject.

The term "Contra-Polar Energy," hich started the whole thing, remains ndefined. It may have come from ome pseudo-scientific source, but I lean to the original suggestion that it stems from an "April fool" hoax article, inspired by facts or speculation just mentioned.

The term "Contra-Terrene Matter" is likewise unknown to anyone I have yet spoken to, but it looks very much like a more fanciful, colorful version of the scientific term "anti-matter."

FLIGHTS OF FANCY?

Finally, while the subject of anti-matter remains one for scientific speculation, it is a very fruitful one indeed for flights of pseudo-scientific fancy. Get some anti-matter, inject it like a fuel into a chamber made from ordinary matter and you have a prolific source of energy.

Invaders from outer space can be at quite a loss, too. Without necessarily realising it, they may be composed of positive electrons and negative protons. Immediately they and/or their ships come within striking distance of our earth, they disappear in a puff of blue vacuum, or something.

And, of course, it provides a very handy and spectacular method of getting rid of unwanted planets and things. You simply arrange for them to collide with something having the opposite kind of electrons and protons and both conveniently disappear.

But don't get me wrong. I haven't said that such things are impossible. I just make the point that they are as yet well and truly in the realm of speculation, if not of fancy.

Perhaps I may be permitted to paraphrase an old saying having to do with

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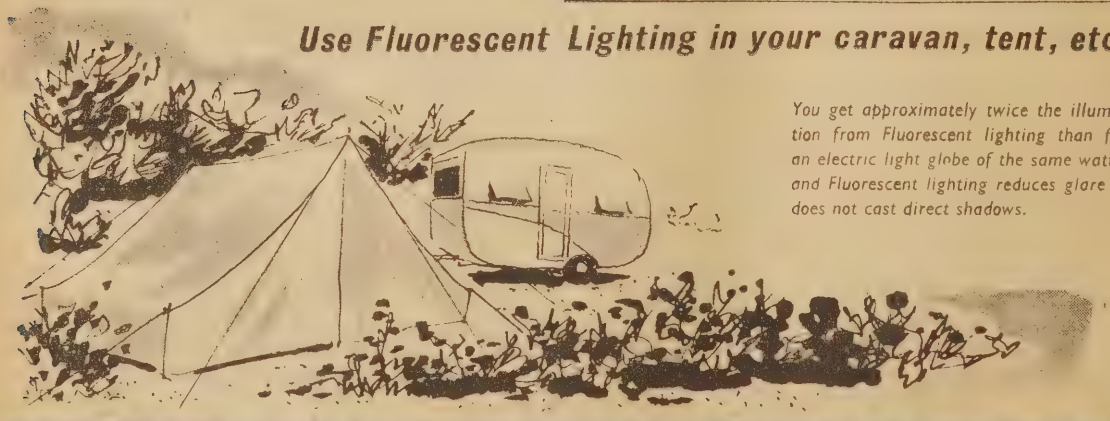

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6017

the preparation of a certain culinary delicacy . . .

"First catch your anti-matter!"

That seems to be the hard part, just at the moment!

As I mentioned earlier, I was all set, when I returned from holidays, to philosophise about radio and television generally, though the urge to do so now has been somewhat dispelled. It was brought on originally by the simple circumstance of listening at length to our "Transporta Seven" in a caravan in the Gippsland bush.

"Is that all?"

One might easily be pardoned for interposing such a remark—but it succeeds only in underlining the reasons for my musing.

As I lolled easily on the bunk, I could not but recall my first experience of listening to "wireless" by courtesy of a relative, who managed to spare me one of his earphones for a precious half-minute.

NOT VERY LOUD—SPEAKER!

I remembered how a few weeks after that, we had gathered as a family to listen in breathless silence to the faint sounds emanating from a Brown's "Table Talker."

Nor could I forget the effort which went into searching the local scrub for two of the tallest, straightest, thinnest trees, hauling them to the homestead and erecting them alongside; or the kerosene tin, buried deep nearby to provide an earth; the heavy accumulator and the big dry batteries needed to run the whole thing.

Yet here I was with a cabinet, smaller than any one of the original batteries, listening with the greatest of ease to cricket, to music and even to news bulletins rebroadcast direct from London. No external aerial, no earth, no separate batteries—with far better clarity and far higher power output than we even dreamed of in those early days.

And how many valves? None.

In the intervening years we have seemingly run the gamut of valve development, from the hungry old tungsten triodes, through the dull emitters, the tetrodes, pentodes, heptodes and so on to their virtual rejection for battery powered equipment.

I could never quite get over the feeling of surprise that this device just didn't use valves, which I personally had come to regard as an essential part of radio circuitry. That all the amplification and output were provided by little, impersonal, matter-of-fact things called transistors.

SINGLE SMALL BATTERY

It was hard to accept that the only source of power was a single 9-volt battery. That anybody and everybody could use the set without giving two hoots about running the battery down.

Quite apart from technicalities, the experience caused me to see again the importance of radio to the man in the country.

In the city, surrounded by neighbours, newspapers and television, it is easy and commonplace to regard radio as of no consequence: to recall how long it is since we last listened to a complete broadcast programme.

But back in the country, without television or newspapers, I was glad to listen to it. I sought out the news bulletins and kept an ear open for weather forecasts and bushfire reports that had suddenly become of vital personal interest.

From one district to another it was easy to appreciate the part played in everyday living by the local regional and commercial radio stations.

Hats off to them!

And then, out of all this, I found myself in Melbourne, looking again at television. More than just that — watching a direct telecast in Melbourne of play on the Sydney Cricket Ground.

Within seemingly few years from a Brown's Table Talker to interstate television.

SPACE PROJECTS

But then, upon returning home, one of the first programmes I watched on local TV was an hour-long study by the B.B.C. of man's penetration into space. Over and above the magnitude of the mechanical, physical and chemical problems involved, the electronic circuitry for control and tracking have reached staggering proportions.

And I am not exaggerating in saying this. On every site, from Woomera to Siberia there was a vast array of electronic equipment to be seen — communication, control, metering, tracking, computing, recording and so on. Its design and provision must represent a very substantial proportion of the total cost and effort and, without it, penetration into space would be virtually impractical and useless.

AVIATION LIKEWISE

Yes, from a Brown's "Table Talker" to all this within a few short years.

And when one sees, amongst other things, the simultaneous evolution from flying boxkites to supersonic jets, one is constrained to ask whether we have not just lived through the era of most rapid technological development ever known to man.

The curve of development versus time . . . is it now passing through its peak or is it tending to slope ever upwards?

And, for those of us who have been privileged to grow with the last 30 or 40 years . . . what shall we see if we are spared the same period ahead? And to what end?

It was upon such things that I mused

(Continued on Page 77)

COLOUR — OR PERHAPS OFF COLOUR

MORE TO IT THAN A NEW TUBE

The following is a quote from a recent newspaper report:

"Australian TV sets could be converted at very little expense to receive color programs, a British expert said yesterday.

"He said the Australian set was of such a standard that it could receive both black-and-white and color programs.

"The expert, Mr C. O. Stanley, said he thought the only change necessary would be for engineers to design an improved cathode tube.

"That probably would be the only additional expense for Australian viewers to get color reception.

Mr Stanley is chairman and managing director of Pye, Ltd., England, a director of Associated Television, Ltd., and a member of the British Television Advisory Committee.

"He arrived in Sydney aboard the liner Monterey."

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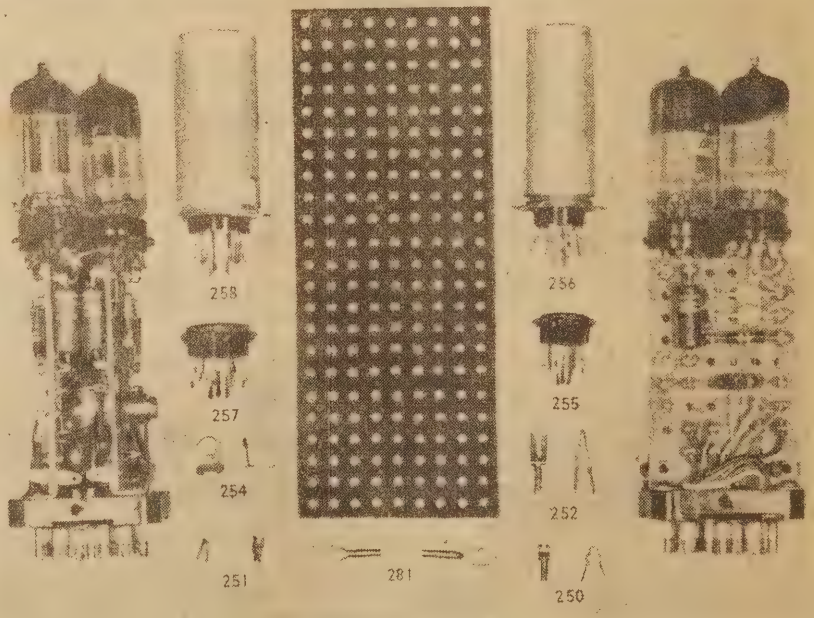

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NEW BOOKS

TV FOR BEGINNERS

A FIRST COURSE IN TELEVISION, by "Decibel." Published by Sir Isaac Pitman and Sons Ltd., London, 1958. Hard cover, 149 pages, 7½in x 5in. illustrated by line drawings and circuits

This book is intended as a sequel to "A First Course In Wireless" by the same author, in that it assumes a fair standard of radio knowledge on the part of the reader. However, assuming this knowledge, it is not essential that the reader be familiar with the other book, since this latest volume is completely self-contained.

As its name implies, it is intended for the student or technician who, well versed in radio, requires a "first step" into this new science. In those capital cities where TV is to be introduced in the coming 12 months it could well prove a very useful and popular book

Written in simple, easy-to-read language, it is an essentially practical book, capable of providing a good groundwork from which the reader may progress to the "heavier" textbooks.

The first four chapters are devoted to history and basic principles of TV in general, the remainder being devoted almost entirely to receiver principles and circuitry. Some of the chapters are: Video Amplifiers, Waveform Generators, Picture Tubes and Associated Deflection Circuits, and Aerials. Each contains a wealth of information.

The last chapter is devoted to colour TV, and while necessarily condensed, will ensure that the reader at least has a grasp of the basic principles of the current and proposed systems.

Altogether an excellent book for the beginner.

Our copy from Technical Book and Magazine Co., 295 Swanston Street, Melbourne. Price 23/9, plus 1/6 postage.—P.G.W.

* * *

AND FOR ENGINEERS

TELEVISION ENGINEERING, by Amos and Birkinshaw. Published by Iliffe and Sons Ltd., London. Hard cover, 268 pages, 9in by 5½in. Illustrated by line drawings, photographs and circuits.

This is the fourth and final volume of a comprehensive textbook on the fundamentals of television theory and practice, written by members of the B.B.C. Engineering Division primarily for the corporation's own staff and now made available to the public.

Previous volumes covered (1) fundamental principles, camera tubes, light and electron optics; (2) video amplifiers, camera head amplifiers, and (3) the

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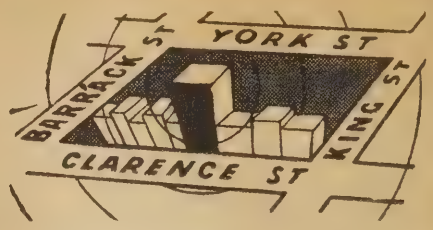

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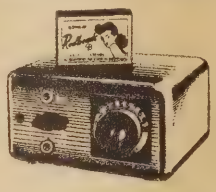

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application of sine, rectangular, sawtooth and parabolic waves to TV circuitry.

The present volume covers such subjects as: frequency dividers, DC restoration and clamping, gamma control amplifier, delay lines, fixed and variable equalisers, scanning coils and frame and line output stages.

As may be imagined, this is no book for the beginner. However, the advanced student, transmission engineer and receiver design engineer will find it contains a wealth of information which, with the previous volume, will make a very valuable contribution to any technical library.

Our copy from Technical Book and Magazine Co., 295 Swanston Street, Melbourne. Price 55/6 plus 2/ postage. (P.G.W.)

LET'S BUY AN ARGUMENT

(Continued from Page 73)

as I sat in a caravan in the Gippsland bush and listened to a little transistor radio.

In conclusion, I wonder how many noticed the newspaper report, reproduced herewith, about the ease with which Australian TV receivers could be converted to receive colour reception.

I only trust in all charity that Mr Stanley was misquoted or that his statements were condensed to the point where they lost all resemblance to the original.

The fact of the matter is that a colour-type TV picture tube is only part of the story. A great deal of associated circuitry is necessary to separate and interpret the colour information superimposed on the normal transmission and apply it as required to the tube. The complications are of such an order that conversion of an existing black and white receiver for colour reception would be impractical.

Australian transmission standards are certainly amenable to the addition of colour information and I gather that some of the transmitters currently in use have likewise been designed with the possibility in view. But there is far more to it than that.

Before colour transmissions could be made the station or stations concerned would have to instal completely new camera chains and studio facilities to derive the signals to feed into the said transmitters.

And the viewers will need completely new receivers to see the colour, containing a colour tube to be sure, plus a lot of additional circuitry and a lot more care with the installation.

Smears, lines and "ghosts" are disturbing enough on a black and white screen but they're impossible when they appear in gay random colours.

No, I suggest that you ignore that particular report.

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The Company believes that Stereophonic Sound is the most exciting development in the recording field since Edison spun his first cylinder. The opinion of those who have attended the Stereo. concerts given in the last few weeks is that Stereo. with its range of dynamic sound has the power to grip the listener and impart the feeling of the presence at an actual performance of a concert or opera. One of the country demonstrations featured a full evening of popular operatic selections, some of which were heard for the first time in this country via the medium of stereophonic sound.

The new "Ortofon" Stereo pick up which has just become available has also aroused great interest, as it gives a taste of the high quality equipment with which this name is synonymous. The price, of course, precludes items such as these from all but the serious minded, but it is a thrill to hear Stereo at its best. On the other hand, for those of us who have to keep within a budget the "Elac" variable reluctance cartridge is an excellent performer.

Some very attractive turntables have become available to us from Japan and there is a promise of some American type Stereo amplifiers to follow from this source. This equipment is beautifully machined to meet the highest engineering standards and is in some respects better than anything Continental manufacturers can offer. Also incorporated are many new and interesting features, such as swing-plate adjustment to accept any type or radius of pick up mounting; speed selector knob with eight positions giving a "drive release" and "off" between each speed.

In the electronics field a new development of miniatured closed circuit T.V. is arriving from Germany. This is a "Grundig" pipe crawler, the complete television camera measuring approximately four inches long and seven-eighths of an inch in diameter. It comes complete with various attachments to enable it to crawl automatically up any diameter of varying pipe sizes inspecting the interior surface, whilst carrying its own illumination and simultaneously cleaning and measuring their internal diameters. It is also available in an indestructible form for use in the inspection of artesian bores and oil wells. This equipment will shortly be demonstrated to many major Victorian industries, as the uses for cameras scaled down to such fantastically small dimensions are innumerable.

Demonstrations of Stereo and Audio equipment can be arranged by contacting the Manager at the above address or by ringing UL1038.

Industrial equipment can also be inspected at the premises of **Victorian Tele-Service Proprietary Limited, 783 Glenhuntly Road, Glenhuntly. Phone UL1038-39.**

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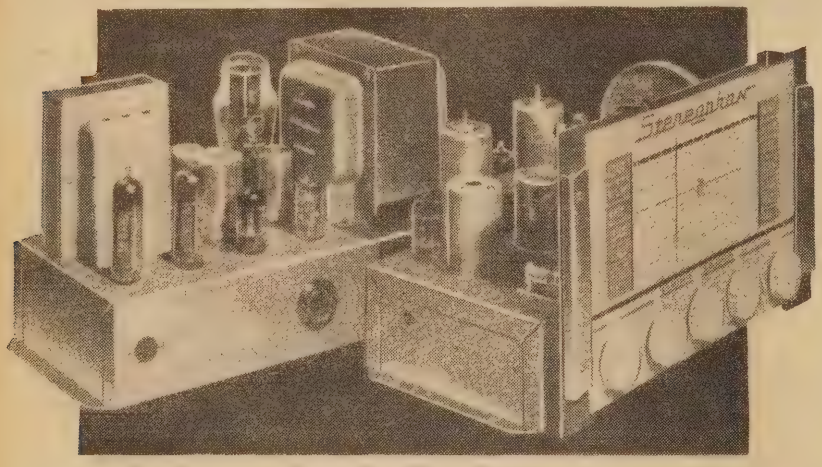

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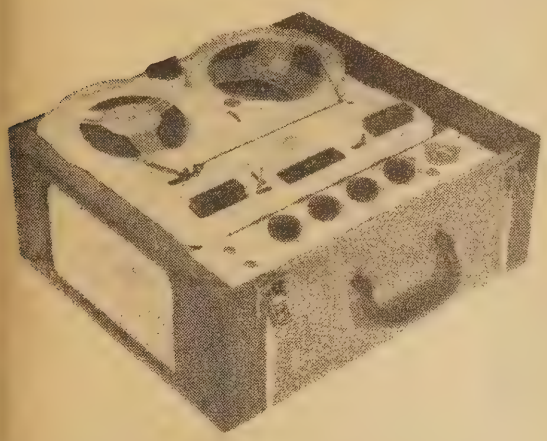

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Heads are double coil wound and will reproduce up to 12,000 c.p.s. at 7½ inches per second. Azimuth adjustments on both impedance "record" and "playback" heads. Output of heads is approximately 5 milli-volts at 1 Kc at 7½ inches per second.
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Instantaneous changes can be made from one track to the other. Fast rewind in either direction
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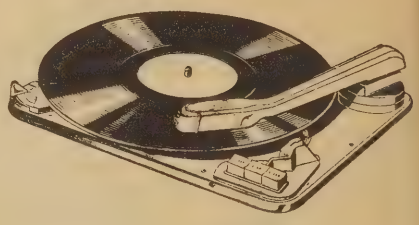

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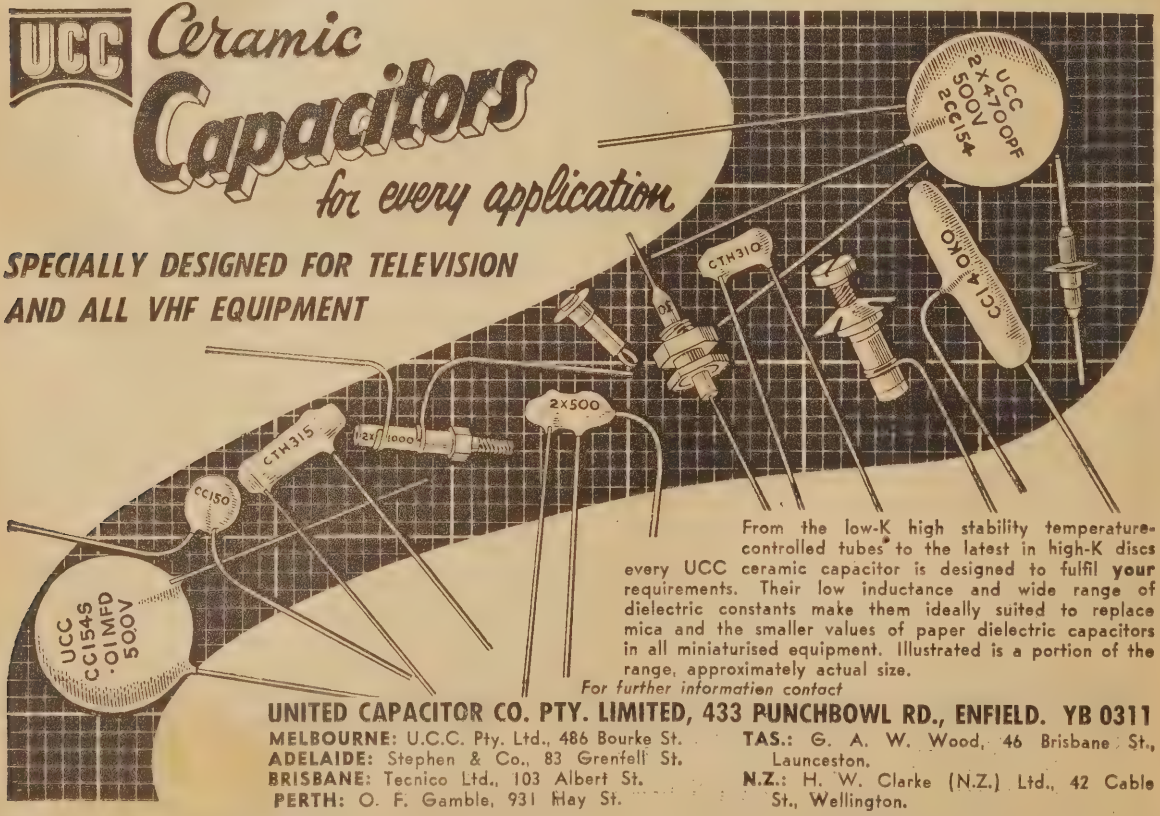

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TRADE REVIEWS AND RELEASES

PHILIPS SERIES OF VALVES FOR 12-V OPERATION

Radical changes in local car radio design are certain with the introduction to this country of valves designed for operation with a plate supply of 12 volts. These valves are suitable for the RF, mixer, IF and early audio stages of car radio receivers.

THEY are intended to be used in conjunction with one or more power transistors, the latter also operating directly from the car's supply and driving the loudspeaker.

Components saved by this system are the vibrator, vibrator transformer, filter choke, filter capacitors and high frequency filter components. Cheaper and more reliable receivers are possible and vibrator buzz, often annoying when the car is stationary, is eliminated.

Several manufacturers are at present turning our "hybrid" valve-transistor receivers which, in general, use four of the low voltage valves plus two transistors.

Samples from the Philips range of low voltage valves were recently submitted by the "Miniwatt" division of Philips Electrical Industries Pty. Ltd.

Type 6ES6 is a variable-mu RF pentode with a 6.3 V, 300 mA heater. With a plate supply voltage of 12.6 and a plate current of 2.5 mA, the gm is 1.8 mA/V at the normal working point. This is comparable with the earlier RF pentodes designed for 250V operation.

Type 6DS8 is a triode heptode frequency converter designed to operate reliably throughout the broadcast band with coils of normal design. The gm of the oscillator section with a 12.6V supply is 1.4 mA/V and the amplification factor 18.3.

Type 6DR8 is a double diode pentode suitable for use as an RF or IF amplifier. The gm is 1.0 mA/V.

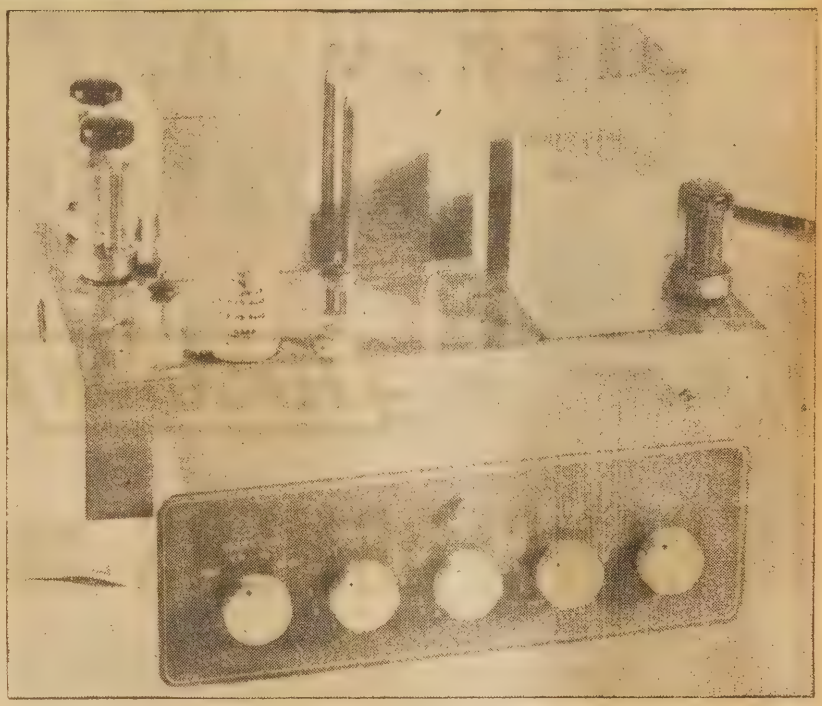
Type 6ET6 is a sharp cut-off pentode which is likely to find application as an audio frequency amplifier.

Rating for operation of the valves with 6V HT have been prepared, but the depreciation in performance is considerable. For example, the gm of the 6ES6 with a 6.3 volt supply is 0.9 mA/V, compared with 1.8 mA/V with the 12.6 volt supply.

From the Philips range the complement of the car radio would include transistor types OC72 and OC16 and depending on the circuit complexity and operating conditions, audio power output between 2.5 and 4 watts is available. Data issued by Philips indicates that the overall performance of the hybrid receivers operating from 12.6V supply is in every way comparable with conventional vibrator receivers.

When transistor prices fall, as they will eventually with improved manufacturing techniques and large quantities, car receivers will, no doubt, be fully transistorised. However, until that time, the "hybrid" series offer a considerably cheaper way of making a high performance car radio.

The retail prices of the new valves are 6ES6 and 6ET6 22/9, 6DR8 23/3 and 6DS8 25/8. Further information is available from the "Miniwatt" Division, 20 Herbert Street, Artarmon, N.S.W.



The A & R 20-watt foundation kit as it appears when completed.

A. & R. AMPLIFIER KITS ARE POPULAR

Good workmanship and component design are features of audio equipment made by the firm of Anderson and Rudie, of St. Kilda Road, Melbourne.

FOLLOWING on their earlier success with amplifier foundation kits, A and R have added two more, one for the Mullard 20-watt circuit and the other for the 3-3 circuit.

In each case the kit consists of all the metal work and, of course, the transformers, both of which are the essentials for good finish, appearance, and high-power performance.

The 20-watt amplifier, for instance, showed up extremely well when tested in our laboratory.

Its output at 1 Kc was 36 watts, with the same amount available at 50 cycles, and 14.5 watts as low as 20 cycles. About 26 watts at 20 Kc can be measured without serious waveform distortion, an excellent power curve.

Its frequency response is flat from 20 cycles to 20 Kc, .5 db down at 30 Kc, 1 at 40 Kc, 2 at 50, 3 at 80, 4 at 95, 6 at 130, and 12 db down at 225 Kc.

Its square wave patterns are quite good, with virtually no detectable overshoot or ringing, but with some rounding of the corners.

Some high frequency oscillation was present with added capacitance of .01 mfds and higher across the output load, but the amplifier was quite stable under ordinary operating conditions.

The 3-3 amplifier, although of more modest performance, also lived up to its specifications.

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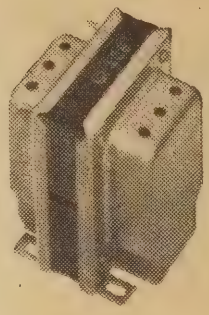

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RUDOLF DIESEL

(Continued from Page 13)

drive turbo-blowers, have been develop-higher powers to be built. Both Bur-meister and Wain and Sulzer Bros. (Win-terthur, Switzerland) now make marine diesels with an output of up to about 24,000 h.p. The challenge to the steam turbine has thus been intensified.

Only in the air has the diesel not won a place. Here lightness and power are assets to be carefully weighed against reliability and economy. The airship R101 and the Junkers Jumo flying boat are perhaps the best known of diesel-powered aircraft.

But the transport does not exhaust the range of usefulness of diesel engines. They are to be found employed for all kinds of purposes: to compress air for pneumatic drills, to drive bulldozers, cranes, excavators or the road roller, which is no longer a "steam-roller," to generate electricity, or to power oil-drilling equipment.

During the 20th century improvements in design have resulted in the creation of an engine which is more compact, easier to operate, and more powerful while maintaining the initial advantages of high efficiency and fuel economy. A century after Diesel's birth the diesel engine has thus become fully integrated into transport and power supply; but even now, especially in the under-developed countries: its development has still to make its full social and industrial impact.

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METEOR BURSTS PROVIDE COMMUNICATIONS

(Continued from Page 23)

Fig. 6. At the transmitting terminal only the differential detector and one Schmitt trigger control the tape recorder. Otherwise the two link-control circuits are identical. The threshold level of the Schmitt trigger, set well above ambient noise, precludes false triggering of the transmitter modulation by noise spikes. This circuit is also filtered with a diode circuit, as in the start-link of the information receiver.

A constant signal-to-noise ratio of about 9 db gives a character-error rate of less than one per cent, using this detection system. Information stops before the signal-to-noise ratio deteriorates much below this level. The 30-millisec time required to stop arrival of information is time anticipated by the burst detector when the signal-to-noise ratio will fall to 9 db. The method of anticipation is based on the assumption that meteor signals have a finite maximum fade rate. This known maximum fade rate establishes a minimum signal-to-noise ratio at the end of all bursts. Extrapolating back to 30 millisec can determine the threshold level of the stop-link trigger, see Fig. 7.

The stop-link threshold is set, generally, at about 12 db and the start-link threshold at about a 16 db signal-to-noise ratio.

The average information transfer rate is approximately 15 wpm with parameters used in the present system. Character-error rates were less than one per cent, but, of these, more than 60 per cent occurred at the end of bursts.

TRANSISTOR MANTEL SET

(Continued from Page 33)

The simplified audio circuit is best suited to the transistor types mentioned. No doubt there will be readers with transistors such as the TS2, TS3, OC70 and OC71, which they would like to use. In this case, we recommend that you include a more complete stabilising circuit, according to the alternative diagram. Some rearrangement will be necessary in order to fit in the additional components.

Current drain of the complete receiver is about 16 mA, the exact value depending on the temperature. It remains substantially steady regardless of the audio volume. This is probably greater than the average drain of transistor portables using class B output stages, but still only about one-third that of the filaments alone of many valve portables.

In order to allow a compact design, we have suggested the 9-volt battery type 2364, and based on an average use of not more than two hours a day, it should last about three months. If size is no objection, you could use the 739, which is available at the same price as the small battery, and which should last about a year with the same conditions of use. The dimensions of the 739 are 1 9-16in by 3 7-8in by 1 7-16in. A small three-pin plug is required for the 2364, while a two-pin plug fits the 739.

In any case, we are sure that you will have lots of fun building and listening to this neat little set which has a personality all of its own.

THE SERVICEMAN WHO TELLS

(Continued from Page 41)

using a little of this flux on his own job, though he hastened to add that he had been careful to wash the surplus away after completing the joint.

Assuming that such flux must be used (as when old and dirty contacts may be involved) I have always felt that cleaning away the surplus with a solvent after the job was done provided adequate precaution. Right now I'm not so sure. It may well be that these fluxes, if absorbed by the water, will eventually bring about chemical changes which will seriously upset the insulating properties of the bakelite.

Summing up, I would offer the following advice to the users of such switches:

(1) At least keep the manufacturers' voltage rating in mind, remembering that more liberal ratings probably are right on the limit.

(2) Take particular care to keep high voltages away from insulated (double) contacts and contacts adjacent to support pillars. The 300 volt rating applied to these may be more realistic than the 500 volt ratings applied elsewhere.

(3) Paste fluxes would seem to be best avoided, all possible precautions notwithstanding.

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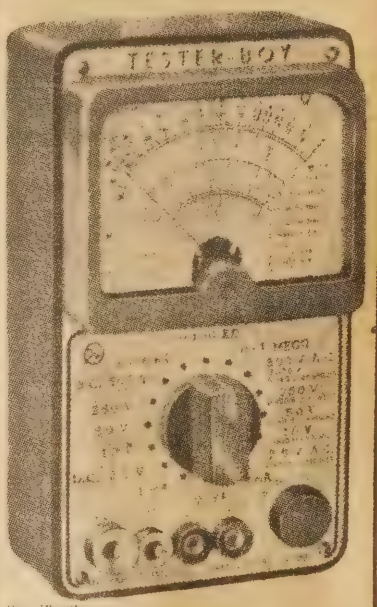

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A COURSE IN TELEVISION

PART 34 — FOCUS AND DEFLECTION

Having examined the generation of sawtooth deflection voltages, synchronised to the transmitter, it is necessary to see how these are applied in the receiver to deflect the electron beam of the picture tube. This will involve some elaboration of earlier discussion on the tubes themselves, progressing to a study of deflection amplifier stages.

THE basic principles of cathode-ray tubes were explained in part three of this present course, in the November, 1955, issue. If revision is needed, reference should be made to that issue or to a suitable elementary textbook.

In the intervening period, television has become firmly established in Australia and many matters which were then the subject of speculation have now become proven facts. It may therefore be helpful to amplify some aspects of the earlier article and to indicate lines of current development.

The first point has to do with focusing methods.

FOCUSING METHODS

As pointed out in the original article, the electron beam in a picture tube can be focused by electromagnetic or electrostatic means.

In the first case, the tube can use a rather simpler gun structure, the electrons emerging from it in a parallel but non-focused beam. After leaving the gun, they are caused to pass through an axial magnetic field, which can be adjusted to make the beam focus at the point where it strikes the fluorescent screen.

The principle of magnetic focusing is illustrated in figure 184.

The behaviour of electrons passing through a magnetic field is summarised by a law which states that:

When an electron moves through a magnetic field parallel to the lines of force, it is not subject to any deflecting force. However, if it moves through a magnetic field at an angle to the lines of force, it is subject at each instant to a deflecting force which acts in a direction perpendicular to its own movement and perpendicular to the lines of force.

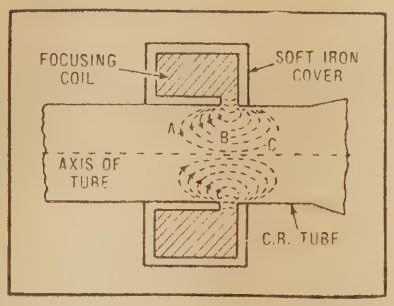

Figure 184: This diagram illustrates the focusing action of a magnetic field on the electron beam in a C.R. tube. More modern practice favours the use of adjustable permanent magnets though electrostatic focusing methods are currently displacing the magnetic system.

The amount by which the electron is deflected is proportional to the strength of the magnetic field acting upon it and inversely proportional to the electron's own velocity. This last depends, in turn, on the geometry of the tube and the accelerating voltages applied to it.

Assuming that the focusing field is symmetrical in figure 184, electrons passing along the axis of the tube will travel parallel to the lines of force and will therefore not be deflected from their original path.

On the other hand, electrons which have diverged from the centre line will encounter the magnetic field, for example, at point "A." Here the lines of force are at an angle with the axis of the tube and with the direction of electron motion.

As a result, the electrons are deflected sideways in a way which would lift them as it were, or depress them obliquely below the surface of the paper—depending on the polarity of the focusing field. The greater the initial divergence and angle to the lines of force, the greater would be the deflection.

As electrons progress through the field they tend to spiral towards the axis of the beam, so that the electron paths are convergent as they leave the field in the vicinity of "C." The object is to vary and control this convergence effect so that the beam is focused into the smallest possible area just where it strikes the fluorescent screen.

The position of the magnet on the tube neck is significant to its focusing action, as also is the design of the associated magnetic circuit.

TYPICAL SCHEME

Figure 184 assumes the presence of an iron yoke to concentrate the lines of force but the position of the assembly on the neck may be dictated as much as anything by the room left for it after the deflection yoke has been placed in position. The point of this remark will become evident a little later.

Early practice was to design the focus assembly as an ordinary electromagnet and, in fact, it closely resembled both physically and electrically the field coil assembly of an electromagnetic loudspeaker. Having been locked in a suitable position on the tube neck, exact focus was achieved by adjusting the current flowing through the focus coil.

Figure 185, reproduced from our earlier Television Course, shows a typical scheme whereby the coil was tapped across portion of a resistor in the negative HT return circuit. Moving the position of the tapping allowed the current through the coil to be varied at will.

The focus current required in typical cases varied between about 30 and 100 milliamps.

With the evolution of cheaper and better permanent magnet materials and techniques, the electromagnetic focus-

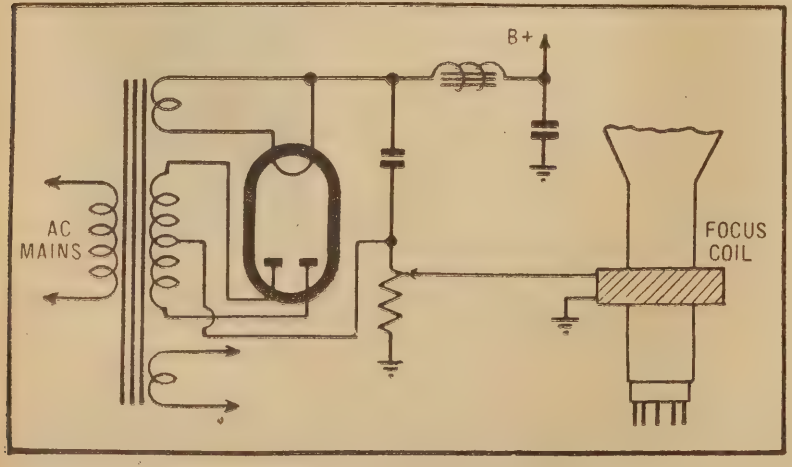

Figure 185: An early method of controlling focus was to pass a current through the focus coil obtained from the negative H.T. return circuit. Focus adjustment involved varying the tapping point on the resistor.

ing system has gradually been displaced. One method has been to replace the actual coil in the assembly of figure 184 with a permanent ring magnet.

To control the magnetic flux within the tube neck, a metal ring is provided which can be slid across the magnetic gap. With the ring out of the way, the strongest field is apparent within the neck of the tube. As the ring bridges the gap, however, it gradually reduces the external field, ultimately permitting the optimum focus condition to be achieved.

More recently, with the evolution of moulded magnetic components, the scheme shown in figure 186 has been commonly preferred. Two separate ring magnets are used, mounted side by side on the tube neck but with their magnetic polarity in opposition.

COMPLEX FIELD

When separated, as shown, a complex field is produced in the neck of the tube, which has a pronounced and uniform convergent effect on the electron beam. As the magnets are brought together, usually by moving the one at the rear, their magnetic fields tend more and more to cancel and less flux is evident within the tube neck. By suitable adjustment, accurate focus is possible.

It is common practice to assemble the two focus magnets into the same cover or housing which serves the deflection yoke, so that it becomes a composite focus/deflection unit.

As an alternative to the magnetic system, it is possible to achieve focus of the electron beam, by reason of the number, the shape and the potential gradient of the electrodes constituting the electron gun. This is known as the electrostatic system.

Normally, the potential on one electrode, often called the "focus anode" is made variable, all others being operated at the approximate potentials specified for the particular type of tube.

Electrostatic focus has long been standard with small C.R. tubes used in oscilloscopes, etc. and its early limitations have been painfully apparent in many such instruments. Chief difficulty is normally the inter-relationship of focus and brightness, which becomes a problem indeed when the electron beam has to be intensity modulated, as for a television picture.

FOCUS ADJUSTMENT

Over the years, improvements in tube design have gradually reduced the magnitude of this problem to the point where a given focus adjustment holds good for any order of intensity variation likely to be required.

More than that, the adjustment has been rendered less and less critical to the point where it is now possible to do without a continuously variable potentiometer type focus control.

Many receivers currently produced in Australia simply have a wander-lead attached to the focus anode, which can be soldered to earth, B-plus or B-plus boost (typically 0, 250 and 500 volts), whichever gives the best focus for the particular tube in use.

Because the focus is so non-critical and need not be touched by the user, it is often referred to in sales and technical literature as "automatic" focus.

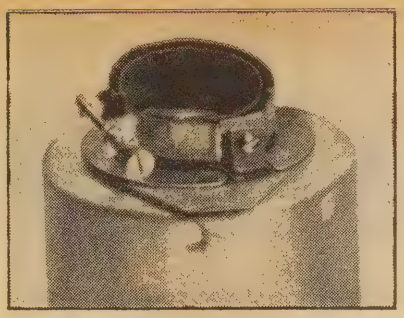

Figure 186: Where currently employed, magnetic focusing normally involves the provision of two moulded ring magnets, placed side by side with polarities opposing. Adjusting the distance between them allows the necessary focus to be achieved.

At the time when our original article was written on picture tubes (Part 3 of this Course, November, 1955), it appeared that most, if not all, local manufacturers would use magnetically focused tubes. Many, in fact, did so but others elected to standardise on electrostatic focusing and the electrostatic method is now employed almost universally.

It would appear that any attendant difficulties in "gun" design have been eliminated and it is now easier and cheaper to build the focusing provision into the tube than to add adjustable magnets externally. Another important point is that stresses on the tube neck are eliminated, arising from the weight of the focus magnets, while there is no risk of the focus being upset by vibration during transit.

As distinct from beam focusing, a very necessary and supplementary function is that of centring the beam and the picture traced out in respect to the screen area. In a theoretically perfect tube and system, a non-deflected spot would strike the exact centre of the screen and, upon deflection, would trace out a symmetrically placed image.

In practice there are many factors which can compromise this ideal state of affairs, as under:

(1) The "natural" position for the non-deflected beam may not be along the precise axis of the tube, either due to misalignment of the gun structure or non-correspondence of the gun position and the corrective effect of the ion trap magnet.

(2) The beam may suffer some initial deflection due to stray magnetic fields from a loudspeaker magnet, a filter choke or even portion of the receiver chassis.

NON-LINEAR DEFLECTION

(3) The deflecting signals may not be entirely linear, slight stretching of the picture making it appear to be misplaced on the screen.

(4) The phase of the picture information relative to the synch. pulse may be such as to displace the picture bodily on the raster. The picture may therefore not be centred on the screen area.

Overall correction for any such fac-

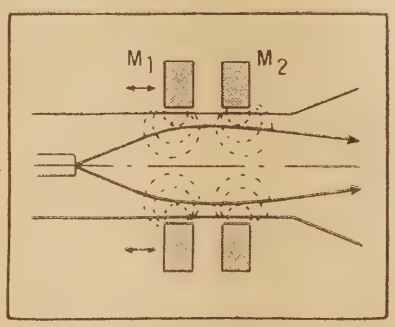

Figure 187: A pair of centring magnets attached to the rear of a deflection yoke. With the levers together, the magnets cancel to produce near-zero flux. Maximum flux and therefore maximum deflection occurs with the levers 180 degrees apart.

Figure 188: This is a typical focus/deflection unit as employed in the earlier Australian-made receivers. Portion of the deflecting coils are visible at the top, energy being fed to them via the cable and plug. At the bottom are the adjustable focusing magnets, as in figure 186. The lever protruding at the right is the centring adjustment. The unit was designed for 70-degree deflection picture tubes.

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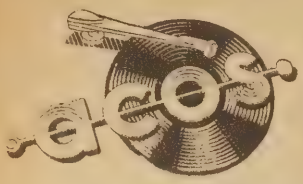

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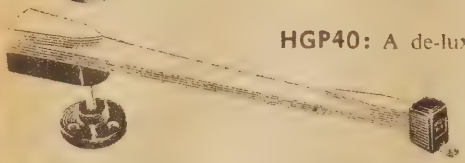

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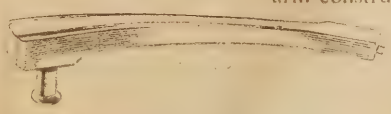

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tors can be effected within reason, by applying a permanent initial deflection to the electron beam.

Once again, this can be effecet ed by either electrostatic or electromagnetic means. The former method is commonly employed in test oscilloscopes, being effected by varying over a small range the initial DC potential on the electrostatic deflection plates.

Tubes intended for TV display do not incorporate deflection plates and, even if they did, there would be no ready means of obtaining differential shift or centring voltages. In consequence, the desired result is always achieved by a magnetic system.

CENTRING MAGNETS

The system most commonly used is to have two very thin magnets, which look rather like washers large enough to slip over the tube neck and with an extension on each to serve as lever. The two are held close together by clips but can be rotated with respect to each other and to the tube neck.

In some cases, the clips hold the magnet rings on to the tube neck by spring pressure, the others they attach them to the rear of the deflection/focus assembly.

When the magnets are rotated in one particular position with respect to each other (usually with the levers together) their magnetic fields cancel and the electron beam is not deflected. Rotating one magnet with respect to the other reduces the cancellation effect and the resulting flux deflects the beam through a small angle.

The direction in which it is deflected relative to the screen depends on the axial position of the two magnets. Rotating them as a group will cause the picture to rotate on the screen so that correction can be effected in any desired direction. The degree of correction depends on the degree to which the magnet fields add or cancel.

Variations of this sch - use levers which move the magnet rings vertically or sideways with respect to each other and/or the tube neck. As a rule, their effect is sufficiently obvious not to require lengthy speculation.

Coming to the matter of beam deflection, this can be achieved, as explained in the earlier article, electrostatically by plates inside the tube, or magnetically by deflection coils external to the tube.

OSCILLOSCOPE TUBES

CR tubes used in test oscilloscopes generally employ the electrostatic method and it should therefore be relatively familiar to most readers. More than that, a large number of readers have built up "experimental" receivers, using CRO tubes, for television reception.

While valuable as a means of diversion and instruction, such makeshift receivers likewise indicate the inadequacies of conventional oscillographic CR tubes for television presentation. Apart from matters of colour and focus, the screen is much too small for comfortable viewing and the brightness range far too limited.

To improve the focus and brightness of a cathode-ray tube sufficient for TV presentation, it is almost axiomatic that the final anode or EHT voltage be substantially increased. This introduces an immediate complication, because increasing the accelerating voltage and therefore the velocity of electrons in the beam makes them proportionately more difficult to deflect.

In practice, this is a serious matter, because the deflection voltages required at the deflector plates rise to such an order as to present serious design problems for the deflection amplifiers.

The problem is further aggravated by the need for larger screens. Unless the tube is made inconveniently long, a larger screen can only be filled by deflecting the electron beam through a wider angle—thus demanding still higher deflection voltages.

In short, the problem of deflection voltages and of preventing the simultaneous defocusing of the beam by these voltages reaches such an order that the scheme has long since been abandoned. Apart from odd experimental receivers mentioned earlier, built up around ex-disposals CR tubes, all television tubes and circuits nowadays are based on magnetic deflection.

MANY PROBLEMS

It must not be assumed, however, that magnetic deflection is a simple matter, by contrast. Its application to modern television receivers has necessitated the solution of many problems and the evolution of many very specialised valves and components. However, it has proved to be a completely practical commercial proposition.

One of the vital factors influencing its adoption is the successful adaptation of the line deflection circuitry to produce the necessary EHT voltage for the picture tube, more or less as a by-product of its operation.

This will be studied in detail a little later but, in brief, advantage is taken of the fact that a very high peak voltage is generated across an inductor when the current through it changes abruptly in value. It happens of necessity when the flyback pulse is applied to an inductive line deflection circuit.

By extending one of the associated windings sufficiently, a pulse amounting to many thousands of volts can be produced and is transformed into high voltage DC, by rectification and filtering. The need for a separate, expensive E.H.T. supply, operating from the power mains is, therefore, eliminated.

Picture tubes currently used in Australia operate with EHT voltages ranging from about 12 to 20 kilovolts, invariably obtained from the line output circuitry.

When the original article on picture tubes was presented, it appeared that the "standard" type of tube for some years would be one having a 17-inch screen (as measured diagonally), and so designed that the electron beam would need to be deflected through a total angle of 70 degrees, to fill the screen area.

CURRENT TRENDS

As it transpired, however, buyers showed an obvious desire for larger screens and this has been met by the use of 21-inch picture tubes designed for 90-degree beam deflection.

Currently, there is a swing towards the use of tubes having a beam deflection angle of 110 degrees, chiefly because such tubes can be shorter for a given screen size thereby allowing the use of shallower receiver cabinets.

The preference is still for 21-inch tubes but 110-degree 17 and 14 inch types are in demand for smaller receivers or portables.

(To be continued.)

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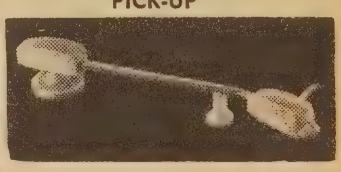

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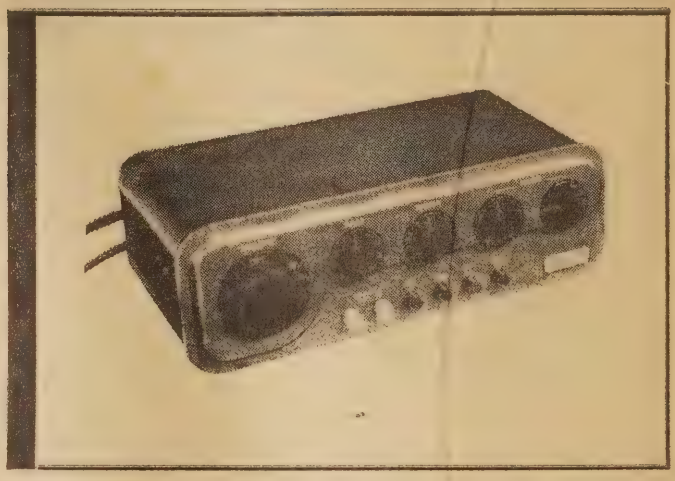


The Quad II amplifier is, in every respect, able to produce the closest approach to the original sound. This is the criterion, whether it is being used for radio, recordings, tapes, or microphone, the Quad's superb quality is reflected throughout the electrical and mechanical design. It gives a power output of 15 watts throughout its frequency range 20-20,000 c/s with an input sensitivity of 1.4 V.

*Except for Chairside Cabinet, prices mentioned are fixed in all State capitals.

Quad QC II Control Unit Specification

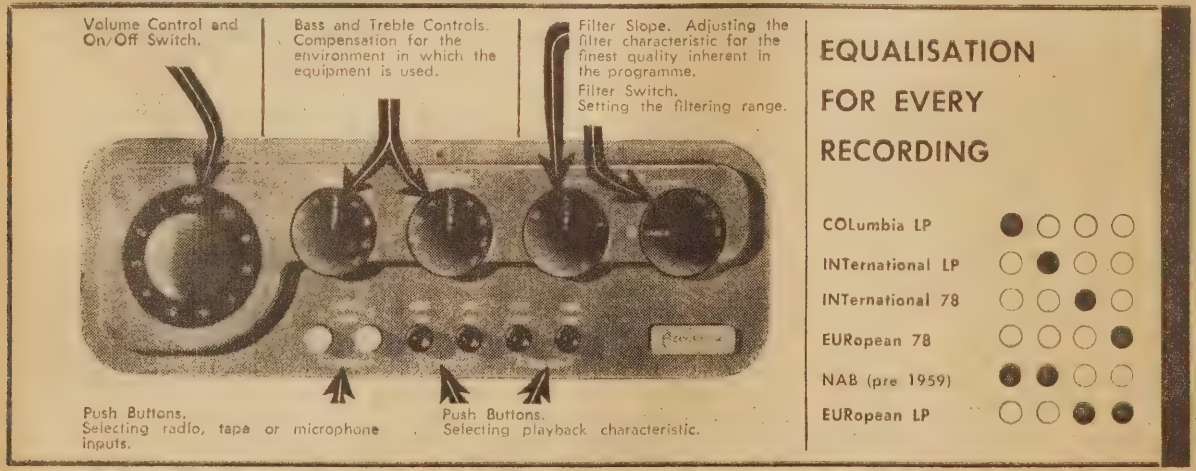
FREQUENCY RESPONSE:
Cancel position, Radio & Tape inputs: 20-20,000 c/s within 1db.
Cancel position, Microphone input: 20-18,000 c/s within 1db.
Cancel position, Pick-up input R.2. Within 1db of stated characteristics. No significant change.
Bass and Treble controls: Within 1db. of published curves.
Filter frequencies: 5 Kc/s, 7 Kc/s, 10 Kc/s ± 250 c/s.
Filter slope: Level to approximately 50 db Octave.

INPUT SENSITIVITIES (for 1.4 V.rms output):
Radio and Tape ... Internal impedance ... 100 KΩ : 100mV.
Microphone ... Internal impedance ... 100 KΩ : 1.5mV.
Pick-up ... Depending upon adaptor unit

DISTORTION (1.4 V. output):
All controls "level," Radio output or R.2 pick-up input: 0.02% approx. Least favourable arrangement of controls: less than 0.1%.

POWER SUPPLY:
The unit takes its power from the main amplifier.

BACKGROUND:
—70 db. or, where applicable, approximately 6 db. above equivalent thermal noise of input impedance.
DIMENSIONS: 10½" x 3½" x 6½". **PRICE:** £54/-/-.


Volume Control and On/Off Switch.
Bass and Treble Controls. Compensation for the environment in which the equipment is used.
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Push Buttons. Selecting playback characteristic.

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POWER OUTPUT:
15 watts throughout the range 20-20,000 c/s.
FREQUENCY RESPONSE:
Within 0.2 db. 20-20,000 c/s.
Within 0.5 db. 10-50,000 c/s.
DISTORTION (measured at 12 watts output):
Total 3rd and higher order: less than 0.1% at 700 c/s.
Higher order alone ..... less than 0.03% at 700 c/s.
Valve mismatching up to 25% not to cause distortion to exceed 0.18%.
Total distortion at 25 c/s not to exceed 0.25%
INPUT:
Sensitivity ..... 1.4 V. rms. for 15 watts output
Load imposed on input ..... 1.5 MΩ in parallel with 10 PF.
BACKGROUND: —80 db. referred to 15 watts.
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Effective output resistance: 1.5Ω for 15Ω output.
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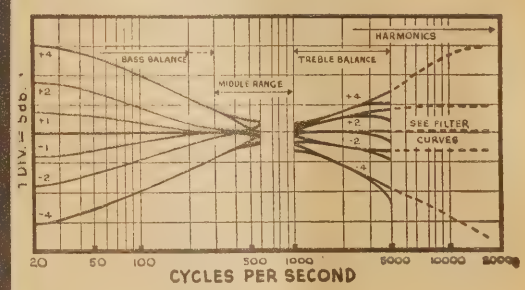
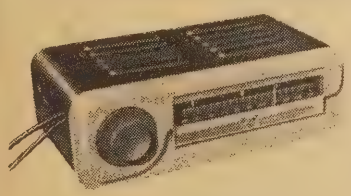


Curves showing slopes of response provided by the bass and treble controls. Adjustment is continuously variable.



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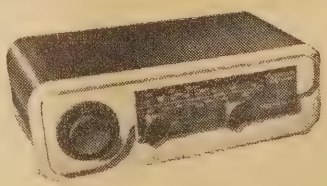

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OFF THE RECORD — NEWS & REVIEWS

The mechanical processes involved in playing back stereo records place very great stress on the characteristics of the stylus tip and the material from which it is made. Any deficiencies, particularly those due to wear, will prejudice the success of the entire system. The stylus problem has always been with us, but stereo has aggravated many of the difficulties to be overcome.

by John Moyle

DURING the month I received the following letter which is self explanatory. Tecnico are setting out to serve the Australian market with a line of stereo equipment, under the Pye trademark, and I understand were the first to announce a model out here by the margin of one day!

Overseas Pye were very early on the stereo scene, and the results of their experience warrant respect. I was very glad to be present at some demonstrations of their new equipment, and to note their efforts in introducing stereo, its problems and its achievements.

Dear Mr Moyle,

Having read your January article "Off the Record," I should like to say how refreshing it is to encounter an all-out enthusiast for stereo — albeit one who had unfortunately not heard the Pye system at the time of going to press. There can be no doubt that when the Australian public hears stereo it will be just as enthusiastic as the people of Britain and the U.S.A.

There is, however, one conclusion drawn in this article with which this company disagrees. We feel that diamond styli will not become "a standard item," but will remain an expensive optional extra.

Look at the position overseas. In Britain, our company has the largest stereo range on the market, with seven different models — yet every one is fitted with a sapphire stylus. In America, the largest stereo cartridge manufacturer is currently producing over twice as many sapphire styli as diamond, and other manufacturers are broadly following this pattern.

It is true that sapphire styli wear more quickly than diamond, and therefore have to be replaced more frequently if the performance of the instrument is to remain as good as when it left the factory. However, the fact remains that here in Australia a stereo diamond stylus is ten times more expensive than a sapphire. For example, one manufacturer's stereo sapphire stylus retails at 13/6, whereas the retail price of their diamond stylus is £7. Saying that a diamond stylus is cheaper in the long run is like saying that the Rolls Royce is the cheapest car in the world. Most people find it more practicable to buy a lower-price car and replace it from time to time.

Yours truly,
P. M. Threlfall,
Managing Director,
TECNICO LIMITED

Without wishing to press the point unduly, I don't think the writer would object if I made a few comments on his letter. And as for enthusiasm about stereo, mine is no greater than that of Pye, who are really "sold" on the new venture.

In saying during the course of the article referred to that "I doubt whether any commercial radiograms will find their way to the market without diamond points," I literally meant radiograms, and not the cheaper and more portable players which without doubt will appear before long.

My hopes were dashed, however, for although some use diamonds as standard, others, including Pye, do not.

Frankly, I am sure they would all like to use diamonds, and in their high quality machines I still think they will. The only case for a sapphire which can be made is that of price, and Mr Threlfall has advanced it as his main objection to the diamond.

But the price difference must become less as time goes on, and I am not alone in anticipating that eventually diamonds will appear much further down in the price range of equipment than they do today.

"Do you like liver, Archie?"
"No I prefer Winifred Atwell."

If the public fully appreciated their advantages I'm sure they would ask for them.

Another of my hopes which has proved to be optimistic is that the industry could keep to the recommended .5 mil stylus in preference to something larger.

Undoubtedly the finer point is the best for best stereo, and I would be surprised if the first-grade pick-ups do not continue to use it, or at least make it available.

But for commercial radiograms, using record changers, for instance, there are difficulties.

Most changers at present use substantially the same mechanism as that developed for standard LP's, and these won't work properly with the average of 3 grams pressure which is generally accepted as being the maximum allowable with such a fine point.

They require a pressure more like 6 or 7 grams.

To avoid very severe stylus and record wear under these conditions, points between .6 and .8 mil have therefore been used, particularly in the U.S.A. and indications are that this practice is likely to extend except for the very best equipment.

Another objection to the light stylus pressure is that vibration near the radiogram, unless the floor is exceptionally stable, will bounce the stylus out of the groove. Even as it is, care must be taken about this.

STYLUS WEAR

Reverting to the subject of stylus wear, we find therefore that the stereo stylus must have an appreciably finer point than for standard L.P.s, but in radiogram use, particularly with changers, must still operate with about the same stylus pressure. Because of its more complicated motion in the groove we might expect it to wear at a more rapid rate, although the point shape assumed under wear may not be as damaging to records as that for L.P.s.

But although the sapphire is so widely used now for L.P. radiograms, because of its low price, it is not and never has been a permanent point. On wide range equipment, distortion due to point wear, even with high-grade pick-ups, is sufficient to be noticeable after say 30 hours of playing, which equals perhaps 40 12-inch discs, and possibly earlier than this.

The fact that ordinary radiograms play more records than this without serious deterioration in quality is simply because the frequency range is so limited that the distortion isn't heard.

Unfortunately, too, when it does appear, it is a gradual process, and the users persist with worn points long after their useful life is over.

And well before this serious wear takes place on every record played with the stylus in this condition. I have had personal experience of friends who have given their radiograms good use for over a year with the same stylus. Not only did a new point work miracles with the sound, but the old stylus, on examination, proved to have no recognisable point left.

A diamond, on the other hand, is estimated to wear probably 40 times as long as a sapphire. Without quibbling over an exact ratio, it would probably outlast the cartridge in which it was used.

I'll leave it to you to estimate whether the few pounds difference in cost is made up for by saving in stylus renewals, in record wear, and in sheer convenience.

If we transfer this position to the stereo field the outlook is even less bright. Assuming about the same stylus pressure, but a finer point, we must expect the stylus to wear much more rapidly than for standard LPs. Because the pickups have two sections coupled together with a device attached to the armature we cannot hope for better compliance, and this, together with pressure, is the major cause of point wear.

In order to check this matter myself I made a point earlier in the piece of using a crystal cartridge with a sapphire in an ordinary record changer arm, but without the changing mechanism and with about 5 grams pressure

It wasn't long before I forked out for a diamond, on inspecting what was left of the point after a month or two of playing.

SAPPHIRE NOT PERMANENT

Summing up, therefore, I think it is fair to say that the LP sapphire point is far from permanent, in the interests of reproduction and record wear it should be replaced very much more often than it is, and cannot compare with the diamond in freedom from these and other troubles.

In the stereo field all these factors remain, but they operate even more seriously. This means that the sapphire must be replaced at quite frequent intervals; even before noticeable deterioration in reproduction is heard. It is obvious, therefore, that the case for the diamond is even stronger than it is for ordinary LPs.

I think what I have said is reasonably factual. What is a matter of opinion is whether the user is willing to pay the difference to get better service. If I was a maker of radiograms with a natural desire to meet competition I might still be forced to retain the sapphire. If I operated the record player only occasionally as a user, I might come to the same conclusion.

But I'd like to see all radiograms with any pretentions at all providing a diamond point as an optional feature, and if possible I'd use it in the first place.

After all, even low-priced cars sell quite freely in their de-luxe versions.

MORE RECORDS FOR 16 R.P.M.

The 16 r.p.m. speed looks like being used at last on many gramophones in which, until now, it has suffered neglect from lack of material.

Its use for music seems limited in the face of the appreciable drop in quality which must result, but for voices it is quite another matter.

Festival have two of local origin, and for which they are to be congratulated.

Dame Sybil Thorndike and Lewis Casson are heard in about 40 minutes of scenes from Macbeth, and a further 20 minutes or so from Taming Of The Shrew, Much Ado About Nothing, and King Lear.

That's one solid hour on a 7-inch disc.

These two are well enough known in Shakespeare to make detailed comment superfluous. The recording is quite good and with plenty of top, although the last few minutes on some sides do show slight deterioration in quality, possibly due to the high cutting amplitude which has been achieved. (Festival FT9901.)

The second features Neva Carr-Glyn in the White Cliffs Of Dover, and Kevin Brennan in Lawson's Andy Page's Rival and The Loaded Dog. (FT-9902.)

Electronic Industries are embarking on an ambitious series of records originally made by the Audio Book Company of America.

Already available is a complete version of the New Testament on 22 7-inch discs, with a total playing time of 22½ hours. The records are included in an album (AR901), which costs £19/19/- and is available on terms.

Despite the size of the project, a large number of albums have already been sold, and they are expected to be in steady demand.

Others will follow, such as a three-record collection of Robin Hood Adventures, something which should keep the kiddies wide-eyed for many a day.

These releases illustrate the vast field open for the very slow-speed discs, and there is little doubt that they are now here to stay.

NEW RECORDS OF THE MONTH

VOICES OF THE SKY—Audio Adventures from Take-off to Touchdown, including F-86 jets, Viscount turbo-props and DC 6-B airliners. Cook 1075.

No one but Emory Cook would bother to make a record such as this, which pretends to do no more than to catch authetic sounds for those who are interested in them.

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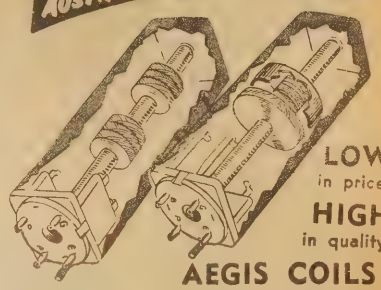

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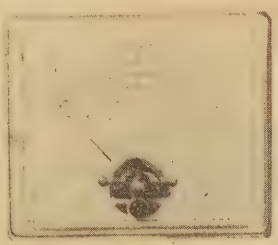

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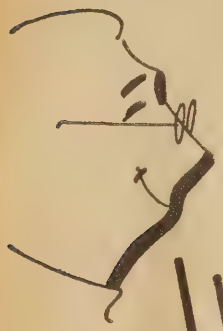

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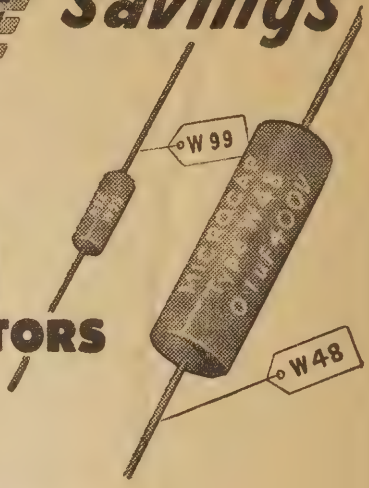

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As I am one of these, I find nothing strange about a couple of sides of aircraft noises—aircraft on the ground, preparing for take-off, leaving the ground and landing, with both piston and turbo-jet engines.

The most spectacular sounds are those made by the F-86 jets in action. Their whistles and roars will give you test material of a type not found elsewhere.

I would have liked some indication of what is happening included, for although most people will be able to follow take-off and landing procedure, including the whine of generators for radio and wing-flaps, a judicious commentary would have helped. Maybe Cook thought that voices would have been an intrusion on his pattern of factual sound, made both outside and inside the aircraft.

It is frankly a disc for the specialist, but its contents are very true to label. The engineering is good, although all but high-grade pick-ups may have tracking troubles on some heavy passages.

★ ★ ★

MOZART—Concertos for Piano and Orchestra No. 17 in G major K453, and No. 21 in C major K467. Played by Andor Foldes with the Berlin Philharmonic Orchestra conducted by Fritz Lehman and Paul Schmitz. DGG LPM 18457.

Foldes and the orchestra play with considerable charm, and with nothing at all of affectation or self-conscious styling.

Without agreeing that Foldes is a substitute for Gieseking, as has been suggested, there is something of similarity between the two men at least in Mozart.

The music is at all times relaxed and unhurried. The pianist has concentrated on accuracy and complete clarity, and he is recorded quite closely so that there is no need for him to overstate.

The orchestra plays in the same mood. It makes no effort to build up size or weight as in Bernstein's version for Coronet.

Foldes looks at things in an entirely different way.

His neatness and precision are well maintained, although he sometimes rushes his turns and trills, and occasionally we are aware of his concentrated care.

Technically it isn't a brilliant disc, but much more valuable is its pleasant, beguiling blend of sound, a piano with a convincing tone which responds well to a quiet touch, and a tuneful body which is much more appropriate than a sharp outline.

The surface is very quiet, and it is very good Mozart.

★ ★ ★

CHOPIN—Les Sylphides Ballet Suite; Piano Concerto No. 2 in F Minor. Played by the Vienna Festival Orchestra, with pianist Carmen Vitos and conducted by Hans Swarowsky. World Record S5.

A combination of quiet surface and clear recording produce a wider range sound than on many earlier World Records.

Most of the solo instruments are very good, and make pleasant listening.

But there are too many excellent recordings of this music to allow room for this one in the top bracket, mainly because the orchestra doesn't play as well as some other famous names. Its discipline isn't really good, or its balance even.

Reverberation is pronounced and this often obscures definition.

I liked the Chopin concerto much better. It is a restrained and poetic performance, mostly straightforward, and clearly recorded. Reverberation again is fairly well in evidence, but the overall effect of balance is much better.

The piano tone is very good indeed, and the fact that it mostly overshadows the orchestra is justified because of its importance and the fact that the orchestra is mainly occupied in accompaniment. There are some beautiful moments on this side.

Once again the surface is good — inaudible, in fact.

This side is one of World Records' best.

★ ★ ★

LALO — Symphonie Espagnole. SAINT-SAENS.—Introduction and Rondo Capriccioso, Havanaise. Played by Yehudi Menuhin and the Philharmonia Orchestra, conducted by Sir Eugene Goossens. HMV ALP 1571.

The star of this record is Menuhin.

I doubt whether in recent years there has been a more unpredictable artist of high rank.

Menuhin commenced his career as a boy genius, and in his youthful period he produced some outstanding performances.

Who has forgotten the historic recording of the Elgar concerto, with an orchestra conducted by the composer?

No one has captured the mood of this lovely work so well before or since. Its revival recently in LP form was a tribute to its place in gramophone music.

Then followed a long period in which Menuhin recordings were all too often deep disappointments. The early prodigy had gone, and there was little of the promise fulfilled.

Even technical uncertainty marred his work, an unpardonable matter in a company which was rapidly reaching new standards of perfection.

But those days seem to have gone. His latest efforts show an assurance and authority much nearer to the kind of thing we had hoped to hear.

I think it was the Bartok concerto which, to me at least, indicated that the master violinist had finally emerged

This mightn't be the very best Lalo you can buy, but you will certainly hear Menuhin at his best.

There is a distinction and individual quality to it, in contrast with the higher power and heavier sentiment which mark the work of others.

The violin is quite prominent — too much so for really top balance, but, as I have said, there is fine playing, tone and dexterity which comes through with hardly a flaw.

Orchestrally, I did not think the record more than adequate. The orchestra always plays well, but there is a good deal of up and down stuff. It has a satisfying fullness and a good, firm bass.

The smaller pieces are of similar quality—Menuhin does particularly well in the last.

A commendably quiet surface adds to the value of this fine release.

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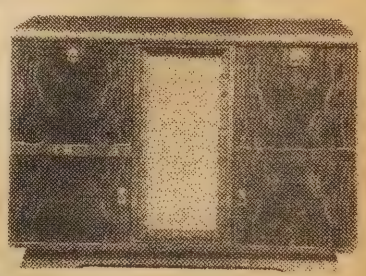

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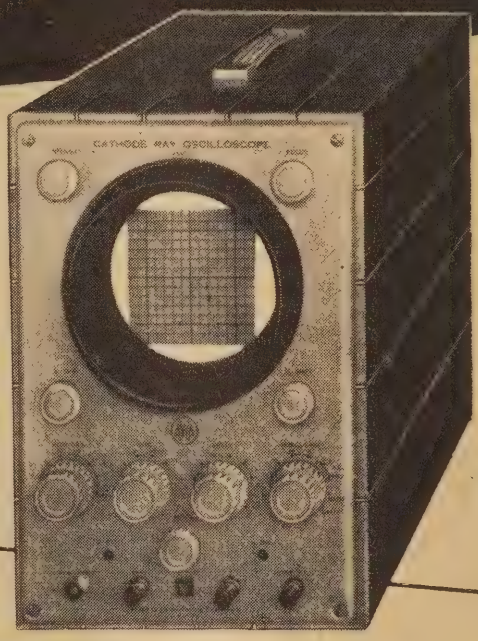

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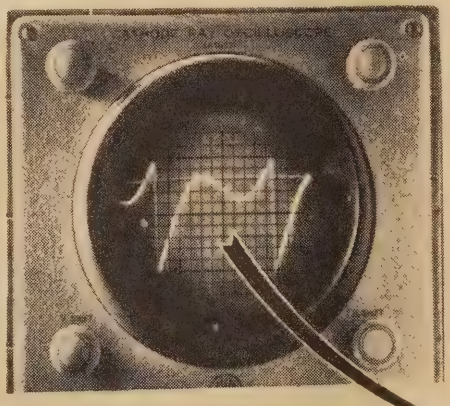

Above is an unretouched photograph of a typical wave form found in the horizontal oscillator section of a TV Receiver.

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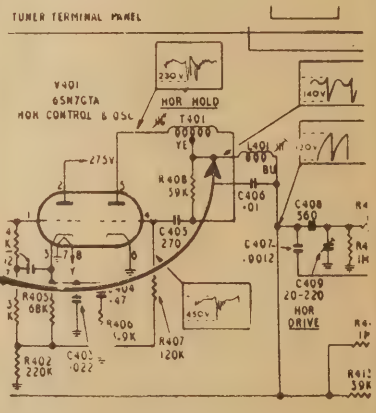

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SCHUMANN. — Sonata in G Minor, Opus 22, Romance in F Sharp, Opus 28, No. 2; Symphonic Etudes, Opus 12. Played by Gary Graffman, pianist. RCA L16151.

Of Schumann's longer works for the piano, the Etudes and Carnaval are probably the most ambitious and the most popular, but there is a great deal of difference between them.

Whereas Carnaval is immediately appealing to performer and listener alike, the Studies are primarily pianist's music, brilliant and difficult to play, but not nearly as melodious.

There is, in fact, more than a hint of monotony hidden in them unless the performer exerts great care and insight.

Graffman has treated them as a challenge to his technique and power, and does not dig very deeply.

It isn't a work of great contrasts, but he could have exploited what there are if he had been prepared to sacrifice some of the desire to hit hard.

One does tire a little of so much full power. The Sonata has a great deal of the romantic Schumann in it, but, although the dynamics are handled appropriately, it has an air of coldness which I don't think Schumann intended.

Despite these comments, and the purely personal opinions in them, one can only admire the great clarity and brilliant dexterity found in all three works.

These qualities at least Schumann would certainly have approved and would undoubtedly have given a great deal to have equalled in his own performances.

And in the quieter moments the piano tone is beautifully controlled.

Played on stereo equipment, as advised by the jacket, it is most realistic. As with most recordings in the stereo era, it is not closely miked, but has a broad atmosphere which is quite true to life.

The tone under pressure is a little hard, and some bass reinforcement is not out of place.

The surface has a slight, even rustle which is not disturbing, although more noticeable on the stereo equipment

Incidentally, it is not a stereo disc, but is equally at home with either type of pickup.

★ ★ ★

GENIUS OF GEORGE WRIGHT, GEORGE WRIGHT GOES SOUTH PACIFIC. — Stereo recordings on the Paradise Theater Organ, Chicago. Hifirecord SR713, SR716.

When assessing the effectiveness of stereo as applied to various kinds of music, many have asked themselves whether it would do anything for a big organ.

My word, it does.

The evidence will be found on four George Wright discs, of which those mentioned above are only two.

One of the others is a "Fair Lady" and it should be good.

Wright has the advantage in that he can divide up his stops to make considerable use of separation, for he is a master of effects and his organ probably has more of these than any other.

A list of its registration given on the jacket proves it.

But it's not just a gimmick exploitation which allows stereo to add so much. This is demonstrated by switching the channels in parallel and playing the records as single channels.

The sense of space and size which stereo gives just falls away, and the end result is just another organ record.

Not being a Wurlitzer fan, I have suffered such records in an effort to be objective, as plenty of people do.

But there is no suffering here. Stereo gives them an entirely new atmosphere, and played with enough power to develop the full bass and really get the air moving, the realism is quite remarkable.

Although it is a big organ, none of its sound is muddied by long reverberation times and auditorium echo. It is remarkable how successfully the microphones have been placed to catch the enormous potential of the huge organ and yet preserve the definition of its numerous effects.

I was very greatly impressed, and some of the tracks have joined my demonstrations specials.

★ ★ ★

500 MILES TO GLORY. — The Indianapolis "500" of 1937 Actuality Recording. Mercury MG20315.

This is an effects record, but it isn't just a collection of racing car noises.

There are plenty of these, but they are a necessary and quite thrilling part of a continuous commentary on the big race as held in 1957.

The first side tells a good deal about the race, how it is organised and run, how the qualifying circuits are arranged and what some of the famous drivers think about it and the sport in general, its dangers and its high spots.

The big thrills are on the second side, which is entirely occupied with a commentary on the race, made at the pits and at several vantage points around the track.

There is even the sound of a crash when one car hits a retaining wall, and, of course, the tension and excitement when it is all over.

It is a straight version of what may be some day released on stereo, for the jacket note makes it clear that there were stereo recorders on the job.

This would without doubt lift it into extra realism, and in my experience few people can resist the fascination of racing cars played on two channels.

There are quite enough people interested in racing to welcome this classic and authentically recorded disc.

Its production and engineering are of high standard.

★ ★ ★

HAYDN — Concerto for Cello and Orchestra in D major, Opus 101; SCHUMANN — Concerto for Cello and Orchestra in A minor, Opus 129. Played by Enrico Mainardo, with the Berlin Philharmonic and R.T.A.S. Symphony Orchestras, conducted by Fritz Lehmann. DGG-LPM 18222.

There are few concertos for cello and orchestra in the concert lists. Dvorak, Haydn, Schumann and Boccherini are the leaders, with the rest far behind in popularity.

And of these, there is some doubt as to whether Haydn was really the composer of the work generally attributed to him. It has been queried not only on matters of historical fact, but also because there are points in style which have led to doubts

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Diameter of baffle opening	7"
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Depth of pad ring to rear	3½",
Finish:	
Baked enamel diaphragm housing, magnet shell black lacquered	
Transformer	Type C
Weight	1 lb 7¼ ozs. without transformer

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Whether this is so or not, it is an attractive concerto and played as often as any.

The cellist is new to me and plays with a full, gracious tone. I thought he was best in the slow movement of the Haydn. In the more demanding passages, he isn't quite as sure as Fournier, for instance, nor does he exhibit the same vitality and imagination.

His outlook is much more restrained, particularly in the last movement, where his grave and measured playing could have been been brightened with some improvement.

Technically, the disc is quite good, and if the overall assessment isn't quite at the tip, it's still very good listening. The grouping could well decide, for I don't think these two are together on any other label.

★ ★ ★

TCHAIKOWSKY — Symphony No. 5 in E minor, played by the Philharmonia Orchestra, conducted by Constantin Silvestri. H.M.V.-QALP 1491.

I would have to hunt through a long list of Philharmonia recordings to find a better one than this.

For a moment, its quiet opening and excellent surface made me wonder whether the recording amplitude was unaccountably low. Then the first powerful chords arrived, and I realised I was merely appreciating a particularly wide dynamic range.

This is a symphony of heavy contrasts and the engineers have certainly not evaded the issue.

In the huge climaxes there is some mighty and magnificent sound.

I doubt whether there is a more beautiful recording of this symphony, whether judged for its great breadth and size or by the balance and definition of its inner parts.

It's the Philharmonia at its very best.

The conductor's measured and calculated exploitation of the emotional passages contrasts with the much higher pressure of the Leningrad's fine recording. But where the latter press on with great urgency and almost violence, the Philharmonia play much more slowly and intensely, although their sentiment never gets out of hand or becomes too banal.

It is tragic enough in this tragic symphony, but its air is always one of high drama, even if these days I like to see less time spent over it.

From every angle, I would class this right at the top of the list, and in many ways it excels all rivals.

★ ★ ★

TCHAIKOWSKY — Symphony No. 6 in B Minor (Pathetique) Opus 74. Played by the Sinfonia of London, conducted by Muir Matheson. World Records TT12.

The Sinfonia of London sounds suspiciously like the London Symphony Orchestra, and it plays well enough for this to be so.

In general terms it is equal to all but the very best, and not very much behind these.

A keen ear will pick up some muddiness in the heavy passages, and some points of balance which do not measure up to ideal standards.

But against this the major portion of the work it extremely good.

It is particularly strong in the bass, so much so that, at full volume, it could be lightened a little to advantage which is the exception rather than the rule.

But most will like the strong undercurrent of basses which give a most satisfying impression of strength and power.

Acoustically it is in the tradition of the best English recordings, and could easily have come from at least two famous studios.

It has little in common with the European orchestras which World Records have used to date.

Musically, it is a straight performance, and if it lacks some imagination and the master touch, it is also free from those individual preoccupation which many introduce to annoy the critics.

There are no unusual tempos but neither are there prolonged agonies. The brass does not tear the air to tatters but it does not lack in vitality and purpose. It is an honest, workmanlike performance, such as one would welcome in any concert hall.

It is a well-made disc, and the surface noise negligible.

★ ★ ★

BRAHMS—Symphony No. 2 in D major, Opus 73. Played by the Berlin Philharmonic Orchestra, conducted by Rudolf Kempe. HMV ALP 1386.

There are some fine recordings of this symphony, and so there should be, for every conductor of note has tried it—Toscanini, Karajan, Walter, Boehm, Kubelik, van Beinum and Boult, to mention only some in my collection.

It is, therefore, very hard to nominate an absolute preference, but this new one could well be it.

If you listen carefully, you will hear why I think Kempe is one of the best conductors of today.

I first heard him in the Ring at Covent Garden, and he entirely deserved the praise he won from both public and critics.

Later I heard him recording with the Philharmonia Orchestra, and have often wondered why the Eroica which they played has not been released.

In this Brahms he directs with the most superb control and sincerity, free of all mannerisms, and with complete deference to the music.

This is the loveliest and most lyrical of all Brahms symphonies, and this is exactly the way Kempe handles it.

It is rarely played with so much understanding and with such accurate judgment of dynamics and emotional gradients.

Kempe knows the value of restraint, and when he wields his strong arm in that grand burst in the last movement, we realise how well he has shaped the whole symphony, and how completely he has absorbed us in it.

The orchestra, too, plays superbly, and the recording brings out every detail of a performance in which not a point has been overlooked or lost.

For me this is the record of the month and one of the finest Brahms recordings ever issued.

It rates the five stars.

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SHORT-WAVE NOTES BY ART CUSHEN

FLASHES FROM EVERYWHERE

SENEGAL station Radio Mauretania on 9565 Kc. is on the air from 4.30 to 6.00 p.m. with news in French at 5.15 p.m., but the reception of the transmission is spoilt by jamming. This frequency was in use formerly from 6.00 to 6.30 p.m., but this latter session has been moved in frequency to 9585 Kc. The session has also been retimed to 6.15 to 6.45 p.m.

HANOI with its broadcasts of the Voice of Vietnam, has been heard on an extended English schedule. This station should not be confused with the Saigon station, using the same slogan and located in South Vietnam. The broadcasts from Hanoi are on the air in English from 11.30 p.m. to 1.40 a.m., using the frequencies of 11840 and 9840 Kc.

This same transmission has also been heard in New Zealand and on the new b.c. frequency of 1200 Kc. News at dictation speed is heard at midnight and at normal speed at 12.30 a.m., with a final newscast at 1.15 a.m.

OMDURMAN transmitters in the Sudan have made an increase in power and using 7500 watts on 5010 Kc., while on 9500 Kc. the power has been increased to 20,000 watts.

DAMASCUS has been noted on 6200 and 6130 Kc. with programs in Arabic from 1.00 to sign off 6.00 a.m. The same program has also been noted on the old frequency for the Syrian station of 6165 Kc.

SOUTH KOREA has made frequency alterations in its English transmissions, and is heard to North America on 15415 and 11925 Kc from 3.30 to 4.30 p.m.

The service to Hawaii which also gives good coverage in this area is now on 11925 Kc. instead of the former 15255 Kc. frequency and is retimed from 5.30 to 6.30 p.m. with news in English at 6.00 p.m. Seoul also carries English from 8.30 to 9.00 p.m. on 9640 and 7935 Kc., and to South Asia from midnight to 1.00 a.m. on 15410 and 9640 Kc. in English and French.

ANGOLA station CR6RZ which uses the slogan Radio Angola and transmits from Luanda has been heard on a new frequency. The station is using 1,000 watts on 9765 Kc. 3.45 a.m., when signals are only weak.

DOMINICAN stations have made some frequency moves, and H15D Santiago de los Caberallos, has moved from 4895 to 4905 Kc. H11Z Broadcasting National at Trujillo City has moved to 6113 Kc., while H13K Ondas del Yatue is on 4980 has extended schedule to 2.00 p.m.

ADDIS ABABA station "The Voice of Ethiopia" has now a classical program 5.30 to 7.00 a.m. and uses 15345 Kc., with English announcements. The station has been heard irregularly on this extended schedule. Another English broadcast. Listeners' Choice is radiated every Thursday, and reports are wanted to Box 1364, Addis Ababa.

KUWAIT Radio in the Persian Gulf which broadcasts on 5000 Kc. has been verified, but sending a prepared card. The station uses the address, Box 4, Public Security Headquarters, Kuwait.

PERU with its Radio National network has added another transmitter, this one is located in Tumbes, uses 9550 Kc., is on the air 10.00 p.m. to 11.00 p.m. and 7.00 a.m. to 2.00 p.m. The station uses the call sign OAX1Z, and relays the medium wave station OAX1K.

SAUDI ARABIA station at Mecca, is reported to have moved one frequency from 11950 to 11850 Kc. The broadcasts, which are in Arabic are on the air 1.00 to 2.45 p.m., 7.00 p.m. to 9.30 p.m., 3.00 to 5.10 a.m.

SPANISH GUINEA, which has a station at Calatriva, is reported to have returned to the air and operates on 6670 Kc. to close down at 6.55 a.m. The station uses "Ave Maria" as a signature tune when they conclude the broadcasting for the day.

BRAZILIAN station Radio Rural, which has been heard on both 6065 and 15100 Kc. has extended its broadcasts. This new station operates 8.00 to 10.00 p.m. and 5.00 to 7.00 a.m. The transmissions are intended for the farming community of interior Brazil. The station address is Ministry of Agriculture, Largo da Minericdia 4, Andar Rio de Janiero.

DUTCH GUINEA now boasts four stations, three are in Paramaribo and one in Neckerie. Radio Surinam on 3990 and 4850 Kc. operates 7.30 p.m. to 12.30 p.m. from Paramaribo. The three other stations have only medium wave outlets.

HONDURAS station Radio Teguicagalpa on 6305 Kc. announces as on the air from midnight to 4.00 p.m., on 6035 and 4950 Kc.

RADIO AUSTRALIA TOPS POLL

The world wide popularity poll which was conducted in January found Radio Australia the most popular short wave station.

AS was the case in 1956, Radio Australia was again placed first in the popularity poll organised by the International Short Wave Club in London.

The first six placings showed little variation from those in the early vote. Radio Australia was 1st, Radio Switzerland 2nd, Radio Netherlands 3rd, B.B.C. London 4th, Radio Canada 5th and Voice of America 6th.

In 1956 Radio Netherlands was 5th and now rises two places, and both London and Montreal drop back one place. The propaganda trio Moscow, Peking and Cairo failed to find interest and, with Radio Australia polling 1,408 points, Moscow had 8, Cairo 2 and Peking 1.

The complete placings of the stations is as follows: Radio Australia, Melbourne 1, Radio Switzerland, Berne 2, Radio Netherlands, Hilversum 3, B.B.C., London 4, Radio Canada, Montreal 5, Voice of America, Washington 6, Radio Luxembourg 7, Radio Sweden, Stockholm 8, Radio Japan, Tokio 9, AFRS, Los Angeles 10, HCJB, Quito Ecuador 11, Voice of Germany, Cologne 12, Radio National, Madrid 13, Belgian National Radio, Brussels 14, Radio National, Lisbon 15, Danish State Radio, Copenhagen 16, Radio Brazzaville, French Equatorial Africa 17, Radio New Zealand, Wellington 18, Radio Paris, France 19, Voice of Israel, Tel Aviv 20th.

Sunspots decrease

THE announcement by the Voice of America propagation expert that sunspot activity reached its peak late last year and is now on the decline will be welcomed by readers. The decrease will continue to open up the lower frequencies, in particular the 6 and 4 megacycle band. The complete cycle takes 11 years and the count of over 200 sunspots late last year is the highest for over 200 years. It takes four years to reach the peak, and then seven years to reach the bottom of the cycle, last peak was in 1954.

The best reception for low frequency reception will not be until 1965, but a gradual improvement should be noted. In the reverse position 11 and 13 metres are expected to gradually weaken in strength, and aurora activity to become more evident in the next few months, often causing a complete blackout of signals.

The Voice of America Radio Amateur program which released the details on sunspot count has interesting information for the short wave listener as well as the radio amateur. The full schedule of the broadcasts heard on Sunday and Monday morning are as follows:

4.00 p.m. on 15165, 15210, 11960, 11810, 11970, 11785, 9740, 9700, 9585, 9530, 7205 and 6140 Kc.

5.00 p.m. on 17845, 15380, 15295, 15210, 11810 and 9700 Kc.

10.00 p.m. on 25950, 25880, 21735, 21455, 17795, 15330, 11875, 11790, 11775, 9745, 9650, 9515, 7160, 7110, 6145 and 6020 Kc.

Monday at 3.00 a.m. on 21610, 21500, 21455, 17740, 15210, 15200, 11875, 11750, 9715, 9520, 7210, 6140 and 3980 Kc.

Monday at 9.00 a.m. on 25630, 21740, 21730, 17880, 17770, 17830, 15230, 15275, 15210, 15200, 15150, 11900, 11895, 11875, 11790, 9615 and 7160 Kc.

The program actually is heard ten minutes after the start of the broadcast, which commences with a news bulletin.

HSK9 on 15380 Kc.

A NEW frequency for the Overseas Broadcasting station of Thailand has been noted on 15380 Kc., during the normal transmission from 8.25 p.m. The station has been heard with an interval signal to 8.25 p.m., when the opening announcement in English is given, as well as the program summary from the transmission from 8.25 to 8.55 p.m. A short musical interlude follows and then the news in English at 8.30 p.m. The station carries news in Malay at 9.15 p.m. and the last 30 minutes is a program in Chinese.

The signal is strong, but the jamming is rather severe and best reception is on Sunday, when interference is absent. The old 24 metre station HSK9 appears to have been replaced by Bangkok in favour of 15380 Kc.

KGEI on 17795 Kc.

THE reinactivation of KEGI after it has been silent for several years occurred last October and was reported in these pages. The station has made an extensive schedule change and has dropped in frequency from 17800 Kc. to 17795 Kc. The station now opens transmission in Spanish at 9.00 a.m. to 10.15 a.m., then a period of English follows to 11.30 a.m. and Spanish is again presented to sign off at 1.00 p.m. Two news bulletins in English are presented daily at 10.18 and 11.00 a.m.

The station which now carries commercial programs from which its income is received, verified by letter and cards. The address for reports is Box 15, San Francisco, California. The station uses the slogan "The Voice of Friendship" and its programs are primarily intended for listeners in South and Central America.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, N.Z. All times are Eastern Australian.

IBIDAN is the possible location of a new Nigerian regional program which is being heard on 3203 Kc. The station has English at 5.45 to 6.00 a.m. and at 6.30 a.m. takes a relay from the National program from Lagos.

MEXICAN station on 6080 Kc. was XEXG, but the station has returned to 6065 Kc. This station relaying the medium wave XEQ program is on the air to 4.00 p.m.

NEW YORK station WRUL which has non commercial broadcasts to Europe has been heard on the new frequency on 15130 Kc. The signal is also on 21460 Kc. and is on the air 6.30 to 7.45 a.m., from Tuesday to Saturday and on Monday from 5.00 to 7.00 a.m.

VENEZUELAN STATION Radio Rumbos, YVLK which is on 4970 Kc. has announced it will soon increase power to 100 Kw. The station is well received opening at 8.30 p.m.

LUXEMBOURG station which carries commercial programs to European countries is heard on 6090 Kc. with interference at times from VL16 in Sydney. The latest schedule for the Luxembourg station is 3.00 to 10.45 p.m. in Dutch, 10.45 p.m. to 11.00 p.m religious programs in East European languages, 11.00 p.m. to 4.30 a.m. in German and from 4.30 a.m. to 10.00 a.m. in English.

TASHKENT in the Asian section of the Soviet Republic has two daily news sessions in English. The broadcast at 10.30 p.m. to 11.00 p.m. and 2.30 to 3.00 a.m. and both are released on 7100 and 11690 Kc.

HONDURAS station HRRH has been observed in Texas on the new frequency of 9585 Kc., from the old outlet of 9531 Kc. HRRH has been observed in the late evenings up to midnight.

BRAZILIAN station Radio Guida, Porto Algera, with ZYU60 on 5965 Kc, is scheduled on the air 7.00 p.m. to 7.00 a.m. At this hour a frequency change to 11785 Kc is made and ZYU61 is used to sign off 2.00 p.m. Greenland Radio Angnagssalik, operates midnight to 12.15 a.m. weekdays only on 7570 Kc with 2000W. The station carries Greenlandic news and its main purpose is to collect weather information and relay them to listeners and shipping in the area.

STANLEYVILLE, in the Belgian Congo, is to have a new transmitter, according to a verification. The power is expected to be increased to 10,000 watts this month and a new antenna should give better coverage. The station, at present using 5940 Kc. has been heard in this country to closing at 5.00 a.m.

BRUSSELS has continued its English broadcasts following the ending of the World Fair and these are now known as "Belgium Magazine." The programs are only directed to North America in two transmissions 8.30 to 9.00 p.m. on 15315 Kc. and repeated at 10.30 a.m. on 11850 and 9665 Kc.

FIJIAN station VRH4, which uses 3980 Kc with 500W, is now operating on a schedule from sign on at 4.30 a.m. to off at 8.30 p.m. On Saturday the station closes at 9.00 p.m.

AMATEUR BANDS WITH BILL MOORE

State conventions of the various divisions of the Wireless Institute of Australia are always well attended. It is one day in the year when country and city amateurs can meet and exchange greetings personally.

THE Ninth Annual Convention of the N.S.W. Division of the W.I.A. was held at the VK2WI station grounds at Dural, north of Sydney.

The event, the best attended since their introduction, saw just on 300 persons in attendance. Over 160 amateurs and associates registered. Country amateurs were there in strength and came from the following country districts: Albury, Coolamon, Canberra, Young, Hillston, Coffs Harbour, Boggabri, Urunga, Newcastle, Blayney, Bathurst and Yass.

Facilities provided were excellent, from the large marquee for lectures to a smaller marquee where Bob VK2ARG, Rod VK2ACU and Peter VK2APP provided other entertainment. The catering arrangements were carried out by a local Ladies' Church Guild and they served just on 200 for tea. All agreed the food was excellent.

The program commenced at 2.30 p.m. with Max Pfeffer, VK2MP, as M.C. and he introduced Pierce Healy, VK2APQ, N.S.W. President.

Pierce officially welcomed those in attendance and in turn introduced his Divisional Councillors.

As the convention was held at the VK2WI site it was appropriate that the next speaker was station engineer Dave Duff, VK2EO. Dave, together with George Rutter, VK2CB, has been responsible for much of the progress in the official station's installation. Dave described the gear in operation at VK2WI.

Members in attendance who had not previously seen the station were greatly impressed and all can be very proud of the VK2WI grounds and installation.

VK2WI operating could be heard all over the grounds via the P.A. system.

John Moyle, VK2JU, the W.I.A.'s observer/advisor for the forthcoming Geneva I.T.U. Conference, then spoke. He outlined his anticipated task at the conference and gave his impressions of the usefulness of such representation and its value in future dealings on amateur radio by the W.I.A. John outlined developments to date and how all the proposals already submitted by the various nations would be returned for re-examination by those Governments that would be participating at Geneva.

Four lecturettes were then presented, the first by Joe Reed, VK2JR, on "Sputniks." Joe showed many charts on the behaviour of these gadgets and moon rockets.

Jack Gerrard, VK2ADN, followed and told of his recent trip and impressions of amateur radio in the U.S. He asked that all W. contacts should be QSL-ed as cards from these parts were really appreciated.

The third lecturer was Max Riley, VK2ARZ, who spoke on the art of "Metal Working." Max described an implement for the effective bending of chassis, boxes, etc.

Final lecturer was Graham Hall, VK2AGH, his subject, TR switching. Graham spoke on the value of always using the transmitting antenna for receiving and how to arrange suitable switching.

All lecturers had spent considerable time on the preparation of their discourses and could have used more time to cover their subjects.

By popular vote Joe Reed, VK2JR's lecture was adjudged the best and won an appropriate prize.

Prizes awarded for home built equipment on display were made as follows: City amateur—Phil Pearson, VK2ZBB, for a finely built 144 Mc/s mobile transmitter. Country amateur—Laurie Cartwright, VK2ZIC, for a home built motor driven generating set. Associate—Dave Evans for a grid dip oscillator.

John Mackie, VK2ZDM, from Hillston, came the longest distance and won a special prize.

An outstanding feature of the event was the disposal sales and amateurs were impressed when in the early afternoon two lorries with eight tons of gear arrived at Dural. Alex Dan, VK2ABU, Allan Williams, VK2FH, and others of the disposals committee were responsible for the distribution.

A surcharge of one shilling per sale realised £25 towards the I.T.U. Fund.

During the evening John Moyle, VK2JU's demonstration of stereophonic recordings was of particular interest to members from the country who had not previously heard this type of musical presentation.

Special records and orcestral numbers were played and the quality was particularly impressive.

Films were then shown, followed by a further disposals sale and the event closed with official speeches. The council thanked members for their assistance.

Undoubtedly the VK2WI grounds are an ideal site for the annual convention and next January will see a further gathering of the division's amateurs.

Prizes were donated by A. W. Valve Co., Mullard Australia, Ducon Condensers and A.W.A.

The initial stage of the convention was the monthly meeting of the division held at Science House. The meeting was badly disrupted due to the Japanese fireworks display. All roads leading to the harbour were blocked and many members were two hours late getting there, the lecturer did not arrive at all.

As a result of much discussion on finance and subscriptions it was decided to appoint a special committee who, together with the auditor Bill Yates, VK2AWY, will report back to the division.

Bob Godsall, VK2ARG, was re-elected Federal Councillor for the N.S.W. Division at the meeting.

Federal Convention

THE Federal Convention of the W.I.A. will be held over the Easter weekend in Melbourne.

Federal councillors from all States of the Commonwealth will assemble to deal with the various agenda items submitted by the State Divisions of the W.I.A. These conferences are the most important held covering amateur radio administrative affairs.

This year's meeting will be extremely significant in view of the W.I.A. representation at the forthcoming I.T.U. convention.

Another W.I.A. event to be held over the Easter weekend will be the North Coast Zone's Annual Convention to be held as usual at Urunga.

Amateurs attending are always ensured of an enjoyable time and inquiries can be directed to Rod Pike, VK2ACU, resident these days at Urunga.

Experiments with scatter

EMPHASIS on scatter working on the VHF bands is still prominent in the U.S. A phenomena originally observed by radio amateurs, radio journals in recent months have carried photographs of the massive arrays now being used in commercial and military installations for scatter net working.

Amateurs with comparatively simple equipment are able to follow this very interesting mode of operation on the 50 and 144 Mc bands.

Two modes of scatter operation are common, ionosphere and meteor.

The first method is used mainly by the VHF gang on 144 Mc to add that extra State to their W.A.S. tally. Currently 40 States on 144 Mc have been contacted by both W9KLR and W9WOK. Even on low power (100 watts or so) S9 signals on 50 Mc and weaker ones on 144 Mc are recorded from meteor trail reflections.

Ionosphere scatter signals vary tremendously in strength with heavy flutter and fade but are always audible between stations located at suitable distances. Such a mode of propagation provides signals regardless of weather, solar or meteor show conditions. It has been adopted as a means of communication by most military departments and has tremendous advantages over normal HF and VHF links.

A most important requirement for scatter working is a clean signal and a stable calibrated receiver. Power is not so important for meteor scatter working but something above 300 watts input is required for ionosphere scatter communication.

Keying speeds are generally varied to suit the varying fade periods and it is necessary to arrange schedules to ensure effective contacts.

The W's have found it possible by means of ionospheric scatter to contact all States within a 1,200-mile radius and can work within a 600 to 1,200-mile range when the 144 Mc band is not open for other modes of operation.

WICEN alert

IN mid-January the N.S.W. W.I. Civil Emergency net was again alerted when heavy rain caused rivers to rise sharply on the North Coast of N.S.W.

A number of homes were flooded in various locations, but fortunately flooding didn't reach serious proportions nor were normal communications interupted.

First news of the impending flooding was provided by Alf Webb, VK2UC, of Lismore, at 9.30 a.m. on January 21, when he phoned State president, Pierce Healy, VIC2APQ.

At 10.30 a.m. the Civil Defence organisation requested W.I.A. State Emergency Co-ordinator Bob Godsall VK2ARG to arrange for the W.I.C.E. net to be alerted. Throughout the rest of Wednesday, all Thursday until Friday afternoon, the emergency frequency of 7050 Kc was manned in Sydney by VK2ARG and VK2APQ. VK2WI, official control station, was in operation during the evenings with VK2EO in attendance. It was arranged should the position deteriorate VK2WI, Dural, would be operated continuously.

Stations all along the North Coast reported into the net and we were all closely watching the position and ready to afford assistance should the position become worse.

Among the stations active were VK2UC Lismore, VK2ADT Urunga, VK2SR Grafton, VK2GI Woodford Leigh, VK2AWS Port Macquarie,

SPECIAL AMATEUR AWARD IN BRITAIN

A SIMILAR award to General Electric's Edison Award for outstanding work as a radio amateur is now available in the United Kingdom.

The donors are Mullard Limited, and it is pleasing to see recognition of the work of radio amateurs in the public interest. The winner each year of the award will be selected by a committee comprising three representatives of Mullard Limited, and three representatives of the Council of the Radio Society of Great Britain.

The award will take the form of a gift in kind (preferably electronic or electrical apparatus and/or books) to the value of £25 and a plaque.

The award will be made to the member of the Radio Society of Great Britain resident in the United Kingdom who, in the opinion of the committee, has through the medium of amateur radio during the preceding calendar year, rendered outstanding personal service to the community by his own endeavour or by his own example of fortitude and courage.

In January of each year R.S.G.B. shall, through its official journal, invite nominations for the award. Each such nomination shall be supported by at least three corporate members of the society and shall be accompanied by a brief factual account of the personal service rendered by the nominee.

The award will commence in 1958 and the first presentation will be made in April of this year.

The award is unique in the annals of amateur radio in that country and members will be gratified to think the work of one of their number will be recognised.

The new president of the Radio Society of Great Britain is one of England's best known scientists Dr R. L. Smith-Rose, C.B.E. Dr Smith-Rose is Director of Radio in the Department of Scientific and Industrial Research and is the author of many important books and papers on radio subjects and a leading authority on propagation problems. He was a member of the council of the Wireless Society of London, the forerunner of the R.S.G.B., and was elected an honorary member of the R.S.G.B. in 1942.

Unusual certificate

AWARDS for operating achievements are common these days, the QST VHG Department points out one that is really worth while winning and it is a wonder one of the National Societies has not thought of issuing it.

The award is membership in the 1,000 mile club on 144 Mc/s.

It is offered by the Raritan Bay Radio Amateurs of South Amboy, New Jersey, for 144 Mc men who have made contacts over 1,000 miles.

Proof of the contacts should be submitted to the Secretary W2TTM at his home QTH.

The certificate is quite attractive and a number of VK's would qualify for the award.

Low powered working

Breaking records is a pastime of many amateurs and since the advent of transistors suitable for HF transmitters the distance being covered by these gadgets has been increased weekly.

One of the latest ventures in this field has been the use of a solar powered completely transistorised transmitter and receiver.

Using such equipment K6LMW has made contacts of 2,000 miles on 28 Mc/s telephony. The input was 75 million watts, contacts were not prearranged and signals reported up to S9 on occasions.

NEWEST R.C.S. PRINTED CIRCUIT RELEASE

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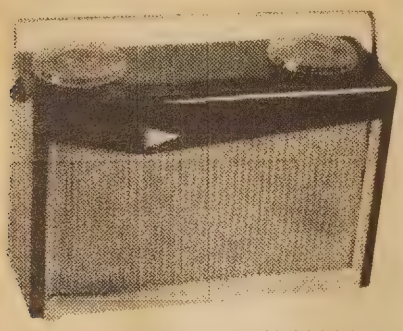

Used as a car radio, the "Transporta 7" connects to a standard car aerial and takes but seconds to unclip and to use it as a powerful, lightweight portable with built-in aerial.
Fits snugly into shielded metal slide under dashboard which partically eliminates all electrical noises. No drain on car battery. Special aerial coil has an extra winding for car aerial and is fitted with extra A.V.C. which minimises fading and null points. Use of 3 I.F. transformers makes it particularly suitable for long-distance reception.

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PART No. 563 consists of:—

Part No. 564 300 pf. Gang Cond.	20/-
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Part No. 562 R.F. Section Printed Circuit	20/-
Part No. 249C Aerial Coil and Ferrite Rod	14/-
Part No. 248 Oscillator Coil	7/4
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Part No. 175 3rd I.F.	11/4
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Boxed kit of parts, as above, Part No. 563, £5/5/- (save 10/4). Coils and I.F.'s pre-aligned. Parts list and circuit instruction. All wholesale prices—plus 25% tax

COIL KITS FOR

either the transistorised portable 6 or the portable radiogram Part No. 560 consist of:—

Part No. 558 Audio Printed Circuit	20/-
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It was clearly shown that the WICEN exercises conducted over the last 12 months would greatly assist traffic handling and net operation in any emergency and so render the net much more flexible and useful.

VHF openings

JANUARY provided VK 50 Mc enthusiasts with excellent medium range contacts and all VK States and ZL districts came through regularly. During the first 12 days of the month these stations were readily contacted from many parts of eastern Australia. Wal. VK2MZ, worked all ZL and all VK except VK1 and 9 in the first few days of January. Quite a number of other stations did just as well.

No DX over the 2,000 mile figure was contacted.

Late in 1958, from October onwards, quite a number of new paths were covered on 50 Mc/s. Perhaps the most interesting was from CT3 (Madeira) to JA3CE, JA3GR and KA2AS. The intriguing part was that the contacts were via the long path. The distance covered was 17,000 miles and one contact was overheard by LU3EX.

Around the same time the band was open on seven days out of 12 from JA to LU via transequitorial scatter.

The band provided trans-Atlantic working for the first time in the season on October 14.

The North to South American path carried signals via TES consistently during their evenings and daylight F2 QSO's were also recorded. At the same time the JA/VK contacts previously mentioned were being made.

A point has been made on how much better for radio work is the current sunspot cycle compared with the last.

It was mentioned that the 50 Mc/s band was only open for Trans-Atlantic contacts for one season (1947) during the last maxima. This maxima has already provided QSO's during three DX seasons, 56/57, 57/58, 58/59. During 1957/58 season the band opened practically daily across the Atlantic.

Among the prefixes heard in the U.K. during period were WI to WQ all VE, HB9, OH2, ZE2, VO, XE and G4LX listed 150 different W's in three weeks.

During this summer 50 Mc DX season it is expected that paths will show about the same MUF's as last year.

Even if the peak of the solar cycle has been passed there will be plenty of surprises. There are now more countries on the band, each year equipment is improving, making prospects of more contacts.

DX honour roll

At the end of 1958 Jock White, ZL2GX, was listed with Chas Mellon, W1FH, and Don Wallace, W6AM, at the head of the ARRL's DXCC Honour Roll. All three stations have 286 countries confirmed. It is the first occasion that any station outside the U.S. has been at the top of the list and Jock should be congratulated for the effort.

Arthur Stowar, VK2ACX, is the leading VK station with 261 confirmed and Gordon Cole, VK2DI, with 260 a close second.

The DX fraternity will be pleased to note that despite Alaska's elevation to the position of the 49th State it will still remain valid as a separate country for DXCC purposes.

The principles on which the ARRL's countries list is based and so takes care of the above conditions are as follows:—

1. Degree of political and administrative independence.
2. Geographical separation.
3. Does the area have "foreign" lands between. Leading political and geographical authorities are consulted before any decision on a new country is reached.

In view of recent decisions Tasmania must surely reach the country status very soon.

The following prefix arrangements identify the location of the various Chilean amateurs. CE1 to CE8 Continental Chile, CE9AA-CE9AM Grahamsland, Antarctica. CE9AN-CE9AS Deception Island, South Shetlands. CE9AT-CE9AZ Greenwich Is., South Shetlands. CEzeroA Easter Island. CEzero Z Juan Fernandez. The latter group of islands was the scene of Daniel Defoe's "Robinson Crusoe." CE prefixes now supply five countries for DX awards.

RSGB Emergency Net

SINCE the initial operation of the RSGB's Radio Amateur Emergency Net activity has been practically confined to the 160 metre band.

Main contributing factor was the ready availability of equipment for this band.

During the past 12 months or so there has been a tendency to change to the 144 Mc band for net operation, both bands have their specific advantages.

The 160 metre band could not be used here in summer months but behaves quite well in Europe in the "ORN" season.

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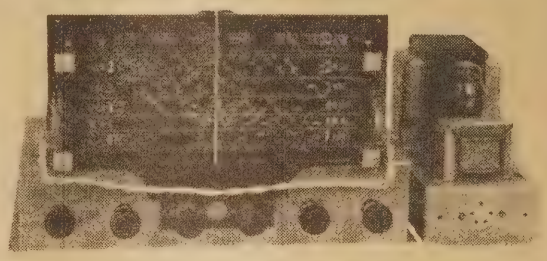

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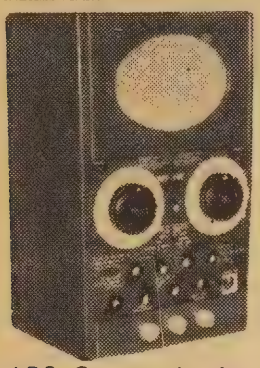

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12v operation. 2 to 10 Megs. Air tested. Perfect order. Complies with P.M.G. requirements. For small ships, bushfires and all other services.

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2 mile Drums.

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1 mile drums £1.

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24 v Operate well on 6 volt. For Car Heaters, etc.

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VT501	12/6	12SL7	12/6
2D21	15/	39/44	10/
1C6	12/6	46	12/6
1J6	12/6	47	12/6
6A6	12/6	78	12/6
3A4	15/	828	£2/10/-
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6V 240V 40 Watt	£3 7 6
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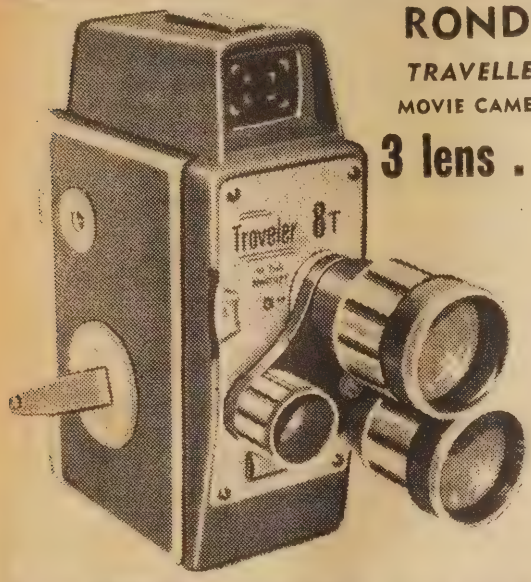

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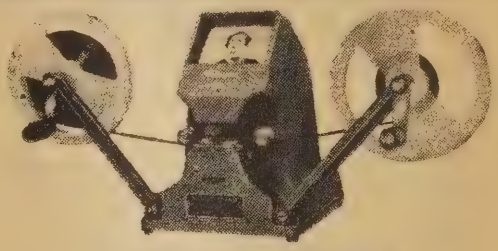

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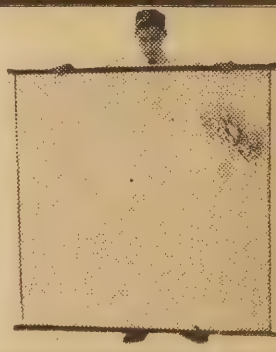

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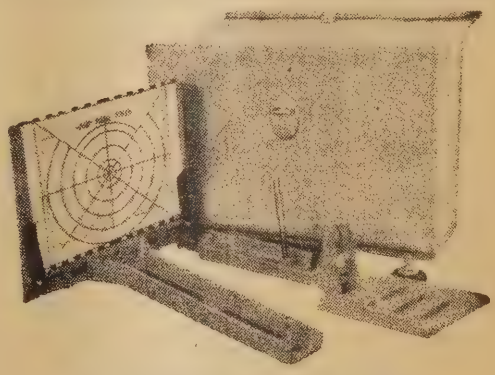

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FASCINATING FACTS ABOUT FISH FAMILY

(Continued from Page 17)

he pattern of the arrangement of the cales are fixed for all time as a charac-eristic of a particular species of fish.

There are three main counts of scales hich are used for identifying a fish. hese are the number of scales along he middle of the fish from the gills the beginning of the tail, the numbei f scales from the centre of the side of he fish to the root of the Dorsal (top) n and the number of scales from the entre down to the root of the ventral ower) fin.

For example, to distinguish between silver bream and a common bream, he difference is as follows. Silver bream, umber of scales lengthwise 44 to 50. ommon bream 51 to 57. Silver bream umber of scales from centre to dorsal n 8 to 11. Common bream 12 to 13. ilver bream number of scales down 5 6. Common bream 6 to 7.

Each species of fish has its own count, ut sometimes the count for different pecies is close enough to make it neces-ary to corroborate the scale count evi-ence by fin shape, eye size and other eatures.

The colouring of fish is an interesting henomenon which is worthy of a full iscussion but only of which an outline an be given here.

The colour is mainly pigments con-ined in small sacs or corpuscles, scat-red throughout the layers of skin.

There are only three types of these orpuscles, namely, chromo, melanin and uanin.

These corpuscles, with the exception of guanin, have a system of nerves which connect with the spinal cord. In the case of the melanin corpuscle, it contains crystals of a black substance named, of course, melanin.

Chromo corpuscles contain two pigments, namely, carotent and xanthophyll. These are responsible for the reds and yellow colourings of fish. Sometimes fish kept in aquariums lack the yellow colours which may be a characteristic of the species. This is due to a deficiency of carotent in the food.

The corpuscles of guanin have no nerve centre. They are responsible for the iridescent silvery appearance of the fish.

Guanin is really an excretion and a by-product of the excretory system and is in the form of crystals which are deposited in the scales, skin, swim bladder and the silver portion of the eye.

Most fish can change colour to a greater or lesser extent. This is done by making use of the nervous impulses to activate the sac or corpuscle containing the pigment.

The sacs are shaped somewhat like stars and if the fish decides that it would be expedient to change colour it brings into play by nerve impulses the mechanism which will either draw the pigment of the cells into the centre of the sac whereby the colour becomes invisible. Or it can spread the colour uniformly into the points of the star-shaped sac, thus making the colour uniform.

It can put more colour into one arm of the sac than another and produce further variation and so on without end.

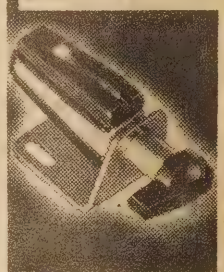
A fish may contain all three types of corpuscles or sacs and by the amount of colour exposed in each sac and the combinations of red, black, orange or yellow which is exposed in combination, so the fish will vary in colour from time to time.

This mechanism is indeed a wonderful thing. In fact, the whole mechanism of a fish is a most intensely interesting matter.

AWA

RONETTE

MICROPHONES & ACCESSORIES



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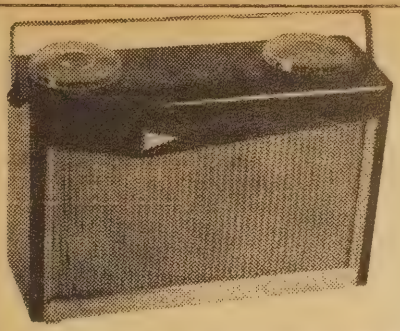

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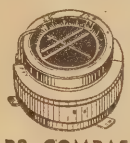

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Variable.
Brand new.

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Suit CSR 536.
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24/- dozen

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In Polished Wooden Case and Leather Carrying Case. Siemens, ex-Army.
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0 to 1 Milliamps, D.C.

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With start of trip indicator £4/19/6.
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MANIFOLD PRESSURE or VACUUM GAUGE

£1 each

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Contain sundry gears. Coil. Electrical and mechanical parts.

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Ex-R.A.A.F. Complete.
12 cylinder platinum points adaptable to 4, 6 or 12 cylinder marine, car or tractor engines.

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1R5	12/6	EB34 ..	7/6
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Ex Command.

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0-30 minus C 0.50 Plus C.
Suit Coolrooms, Electroplating Works and 1,000 other uses.

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EX-R.A.A.F., contains the following lenses:—
One 7/8in F.L. Plano convex 15/32in diam.
One 1 7/16in F.L. Piano convex 1 9/16in diam.
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Each.

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BENDIX.
New, 0 to 3000 r.p.m.

£4/19/6 each

or complete with flexible drive.

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TRANNIES, midget output, 5/ ea.
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2 Potentiometers, .1 meg.; 3 doz. assorted resistors, values ranging from ½ to 2 watts; 9 assorted Condensers; 1 Midget Choke, single wound; 1 Midget Choke, double wound; Output Transformer; 2 H.F. Transformers; 1 H.F. Reactance Ceramic; 1 hank of ass. Hook-up wire, approx. 40ft; 3 lengths of Multi Core Cable, and lots of other items too numerous to list.

THE LOT 45/-

Post, N.S.W., 3/9; Int., 5/2.

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BRAND NEW, NYLEX ROTPROOF COVERED.

£4/17/6 per mile

Freight payable at nearest attended railway station.

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ANSWERS TO CORRESPONDENTS

I.J.K. (Canberra A.C.T.) submits a circuit of an ectronic flash unit and asks us to comment on

A. The circuit appears to be fairly straight forard and somewhat similar to our own circuit scribed in the April, 1954, issue. However, e subsequently used a modified system of switchg between capacitors, whereby an intermediate osition on the switch was used to bridge the two apacitors through a suitable resistor. The varisle indicator scheme probably has some advanges, but all such indicators are approximate nly, since the rate of flashing varies with the pplied voltage. The lamp you plan to use may hard to obtain, but we suggest you contact e Sydney branch of Seimens, 131 York Street.

As far as we can tell from your description the trouble it is due to power-line surges hich cause momentary changes in the frame oscillator output and, therefore, in the height of e picture.

Most receivers are prone to this trouble, and it generally minimised on commercial receivers s allowing a fair amount of overscan (in both irections) so that line voltage variations, either eady or transitory, are not particularly noticeble.

If the trouble is as we suspect, the only cure ould appear to be better de-coupling and/or oltage regulation of the power supply to the ame oscillator/output stage. Both present a umber of practical difficulties and may not be orthwhile.

We regret we have no literaure on TV faultnding, but suggest that the larger bookstalls ould be able to help.

B.B. (Cremorne, N.S.W.) has built a two-stage ansistor set, but is troubled by crowding of ations at one end of the band.

A. Unfortunately you have given us very little nformation with which to work B.B. The exact sue is not mentioned, making it difficult to idenfy the set to which you refer, while it is not tated at which end of the dial the stations rowd, and exactly how many stations are inolved. However, this trouble is not likely o be one of coil design so much as the size and esign of the tuning capacitor, which may be ne of the very old-fashioned type. Otherwise, e must assume that only two or three stations re being received and that these occupy one nd of the band. In regard to a smaller coil, ou will probably already have noticed the deign in the January issue, and may be the type f circuit you require. We are glad to learn hat you have had so much success with the atchbox Receiver and Amplifier.

D.W. (Balwyn, Vic.) has built a TV receiver sing the 12 in 63DS tube, and is very happy with he results except in regard to the brightness of he picture. He wants to know whether we could escribe a 4000-volt power supply to help in this natter.

A. We have no plans for such a power supply at the moment, mainly because, as pointed out n the original article, the use of higher voltages ill severely restrict the deflection possible with he present deflection circuits.

T.B. (Seven Hills, N.S.W.) wants to know whether we are planning description of a TV set ncorporating the 110 degree deflection compoents now available.

A. We have plans to do something along hese lines in the next few months, T.B., though e cannot advise anything more definite than hat at the moment. As you can appreciate, completely new design will be necessary to take ull advantage of the small picture tubes, and lot of work will be involved.

(No name) writes in regarding a lengthy conersation he overheard between two hams, who vere discussing the merits of the new 21 Mc omething or other and mentioned that there vas some trouble with harmonics. The equipent on which our correspondent overheard the onversation was for record playing purposes and vas not equipped with a tuner. As a result, he ssumes that the trouble spoken of was responible for the untimely interference (apparently n the middle of Beethoven's Third Symphony). le hastens to add that the note was penned in spirit of friendly criticism and for whatever nterest it may hold for hams.

A. The amateurs concerned were not necessarily at fault in your receiving their signals. It s probable that the transmitter is close by and hat with a very strong signal rectification will sually occur most likely in the first grid. The udio content will then be amplified in the ormal manner. Improving the shielding and arthing in the amplifier may or may not improve matters, or it may be necessary to introuce a wave trap in the input circuit. We suggest that you contact the amateur and seek his co-operation.

In passing, we would like to point out that it is customary to sign one's name to correspondence, not necessarily for publication, but as evidence of good faith.

N.A.D. (Rose Bay, N.S.W.) sends in a circuit for use on the Reader Built It page. The circuit is of a field telephone constructed from disposals components.

A. Your circuit and description will be passed on to the appropriate staff member who will, no doubt, file it for possible future inclusion on the Reader Built It page.

R. McD. (Eastwood, N.S.W.) forwards a circuit of a two stage transistor set for possible inclusion on the Reader Built It page. Apparently R.Mc.D. was so satisfied with the performance of the One Transistor Receiver that he proceeded to add an audio stage to this set, using an OC71 junction transistor.

A. Your letter and circuit will be considered for possible future inclusion on the Reader Built It page.

G.W. (Mt. Seymour, Tas.) sends in a number of queries for answer on this page. One is regarding the regulations for the operation of a walkie talkie over short distances. Another is regarding the availability of a circuit from our files for a short converter. And, finally, one of the reasons for the reception of shortwave stations together with broadcast stations, when the aerial is placed on the grid of the converter valve.

A. We feel that the first and the last queries are more suitable for the Answer Tom feature. The former has been answered in the Answer Tom feature in the current issue, while the latter will be used in the earliest possible issue.

Circuits of several shortwave converters are available through our files at the usual fee of two shillings per three circuits.

M.A.J. (Mt. Gambier, S.A.) has constructed the amateur bandspread tuner from the January, 1958, issue but is having trouble with oscillation on the 80-metre band.

A. Since this receiver uses a high-gain valve it is particularly important that the shielding between stages is maintained, to the extent of placing the shield plate over the bottom of the sub-chassis and ensuring that contact is made at all points. With the shielding in order, it should be possible to operate the valve at full gain. As you say, it is possible to receive 20-metre signals on the 10-metre coils. However, the sensitivity will be slightly lower and the bandspread will not be correct. The position of the bandset capacitors on the receiver can be set approximately by panel markings. In order to make the bandspread calibrations coincide exactly, it is a good idea to have an auxiliary crystal oscillator which can be switched on for the purpose. If the oscillator operates at some even frequency, such as 1.0, 3.5 or 7.0 Mc., so much the better, but you could use any crystal with harmonics falling within the band.

A.J.B. (Hurstville, N.S.W.) advocates the use of transistors in mains operated equipment as well as units operating from battery supply.

A. The special advantages of transistors are most spectacular when it is necessary to use batteries as the primary source of power. It is, therefore, natural that their use in battery equipment should be exploited first. As far as Radio, Television and Hobbies is concerned, there are literally dozens of transistor/battery projects we would like to develop and publish before we consider mains powered equipment seriously. Low voltage, low impedance and ripple-free power supplies for transistors may be a problem and may require the development of some special new components. Finally the performance of transistorised equipment, except for power consumption and reliability, would not be as good with valves, while overall cost would be much greater.

R.H. (Padstow, N.S.W.) finds that the adjustment of the regeneration of his single-transistor receiver (June, '57) alters after the set has been switched on for a few minutes.

A. The only components which are likely to change significantly over the time you mention are the transistor and the battery. If the set is operating normally, the battery drain should not be more than about 50 uA and transistor collector heating should cause negligible change in characteristics. It would be a good idea to check the collector current to make sure that it is not excessive, due either to a faulty transistor or faulty components. A check of the 47K and the 2.2 meg. resistors particularly is desirable if the transistor is drawing excessive current. The battery should be fairly easy to check, either by measuring its voltage with a meter or substituting a new one. We would like to draw your attention to a later version of the receiver which appeared in the December, 1958, issue. It uses a ferrite ring as the basis of a high-efficiency coil. The overall gain, selectivity and ease of adjustment are appreciably better than the original.

The Radio, Television and Hobbies Query Service

All queries concerning our designs, to which a POSTAL REPLY is required must be accompanied by a postal note or stamps to the value of TWO SHILLINGS.

For the same fee, we will give advice by mail on radio matters, provided the information can be drawn from general knowledge. UNDER NO CIRCUMSTANCES, however, can we undertake to answer problems involving special research, modification to commercial equipment or the preparation of special circuits.

Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to other readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis can be supplied for 5/-. These are available for nearly all our designs but please note they do NOT show wiring details.

Address your letters to The Technical Editor, RADIO, TELEVISION and HOBBIES, Box 2728C, GPO, Sydney.

Note that we do not deal in radio components. Price quotations and details of merchandise must be obtained direct from our advertisers.

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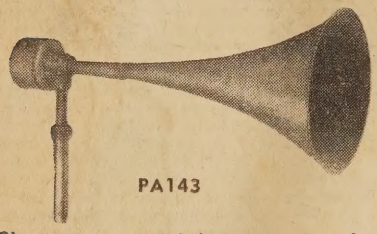
AWA manufacture the most complete range of speaker assemblies—there's a unit for every sound reinforcement need. AWA designs these speakers for maximum faithfulness in sound reproduction. Styles and finishes are available from stock or designed for individual use and circumstance.

PA138

Standard reflex horn speaker for medium distance projection of speech and incidental music.



PA143

Short exponential horn speaker for distance projection of speech only.

PA73

Ivory timber cabinet with 7in. speaker for applications where a bi-directional characteristic is desired.

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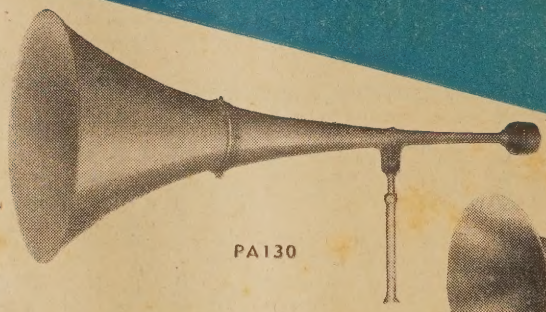
Exclusive features are the self-locating diaphragm and the concentrically interlocked magnet which together produce an indisplaceable mechanical assembly, proof against decentering.

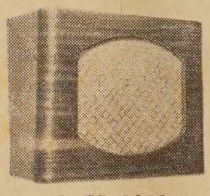


PA130

Standard exponential horn speaker for public address where distance projection of speech and incidental music is required.

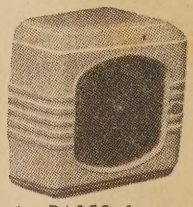
PA10 & PA1

These flare baffles are for use with 7in and 12in permanent magnet cor speaker units and provide high conversion efficiency



PA77/12PS

Polished timber cabinet for wall or table mounting with 12" cone speaker and 600 ohm line transformer



PA150/1

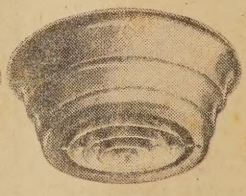
Attractive moulded cabinet with 7in cone speaker and 600 ohm line transformer. Suitable for wall or desk mounting. In grey ivory and walnut

PA343

General purpose source reproducer music and speech ra 100 to 7,000 cyc Power capability 15 w of programme

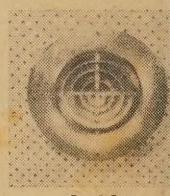
PA218

Designed for overhead mounting in contemporary styling. The unit can be suspended by chain or rod. Gives uniform response over a wide area.



PA188

For overhead mounting this is a surface style unit. 360 degrees diffusion over a wide area in smart styling to suit modern architectural treatments



PA186

For flush mounting, unit has a reces acoustic surround wh mounts the complete sembly above the ceil line. 360 degree di sion

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ONVERTING YOUR RADIO-GRAM TO STEREO

(Continued from Page 63)

e unit to work in with single-ended ceivers which would not have enough rrent capacity to do so.

In connecting the equipment to the wer mains, you will probably find at the receiver already has an earth nnection by means of a three-pin wer plug. If it has not, such a lead ould be provided.

But in connecting the unit, do not e an earth connection in this way.

A double connection will almost cer-inly introduce an "earth loop" which n cause hum voltages to be induced the input circuit.

ARTHING

However, the unit will be securely rthed to the receiver by means of the ter braid of the co-axial pick-up cable, d from a safety point of view this ll be just as effective as an earth ad on the power plug.

Similarly the power cord to the motor ould not have a separate earth lead nnected to the mains, but is best ugged into a three-pin socket mounted the set chassis, or earthed separately this chassis if it has its own mains ug.

The idea is that all the earths should nnect to the chassis of the set, and single lead from the set used to earth e whole equipment to the earth pin its mains connection.

The only alternative would be to mpletely separate the earth connec-n for each channel from input to tput, and this is not practicable with-t a great deal of difficulty.

As we have mentioned it is im-rtant that similar speakers should be ed if at all possible.

From a stereo point of view, if one eaker is noticeably weaker in the iddle or top registers than the other, is is equivalent to a built-in unbalance tween channels at the frequencies ncerned, and it will spoil the clarity channel separation which is the basis good stereo.

ACK OF BALANCE

The speaker which has the more pro-inent middle will always tend to shift e sense of location in its favor, par-cularly when otherwise equal inputs e concerned which ideally should ace the sound between the two eakers rather than to one side.

It is possible, too, that you will notice shift in the positioning of voices or struments as they change their pitch, that the sound appears to wander out instead of remaining stationary.

Such speakers will give some stereo fect, but it will not be the best.

Similarly they should have if possible e same sensitivity. If not you will ve to adjust the sensitivity of the annels to balance them up, and if is is too much for the range of the justment provided, alteration of feed-ck will be the only practicable ethod.

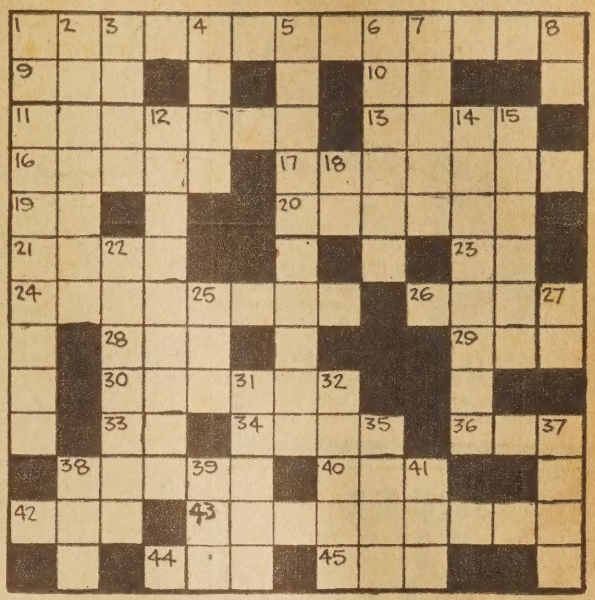
There is some allowable latitude, for en similar speakers may not sound actly the same due to variations in ffling, positioning, and even because different characteristics of the pick-sections.

But don't make it harder than you need to. Almost anything will register separation when this is very definite in the recording, but the full enjoyment of stereo depends largely on the more subtle blending of small channel differences, and these will be clouded and lost if the coloration of the speakers isn't substantially the same.

Big speakers are nice, but they are not essential for low-powered equipment. Units such as the 8MX for instance, go very well if well baffled, and we have found that our small cabinet design as described in the issues of June, 1957, and September, 1958, and illustrated again here will work well with any speakers up to the modest 12 inch types.

At a later date, when we have had enough time to work on it, we will almost certainly produce some detailed designs for simple stereo. But the circuits as shown here are perfectly sound and will give excellent results, and you can use them quite safely as a basis for your own adaptations in the meantime. There is bound to be a good deal of rebuilding in the home construction field, and it is our hope that the suggestions made here will allow you to make a start and learn more about this fascinating new world of sound.

THE R., TV & H. CROSSWORD No. 59



ACROSS

1. Stacked layers of a coil.
9. A distinguished airman.
10. Conjunction denoting an alternative.
11. Act of assisting another.
13. Peril.
16. Disciple of the philosopher Zeno.
17. Instrument for measuring current.
19. Symbol for radium.
20. Crockery used for afternoon refreshments.
21. Suffix meaning little.
23. Physical training (Abbrev.).
24. Fury.
26. Lazy.
28. Greek letter.
29. A contraction for over.
30. Cargo.
33. Long-playing (Abbrev.).
34. Used in glow-discharged lamps.
36. Negative (Abbrev.).
38. Utensil used for separating the fine from the coarse.
40. Facetious intellect.
42. Pronoun of him.
43. Part of transformers (2 words).
44. To place.
45. Fasten together with needle and thread.

DOWN

1. Describes a speaker enclosure which augments the lower frequencies (2 words).
2. The salt of acetic acid.
3. Roman Emperor.
4. Man's name.
5. Bridge for measuring electrical resistance.
6. Ordinary and regular.
7. Eliminates moisture.
8. To pass from one place to another.
12. Used for recording TV picture information (2 words).
14. Describes a transformer for reducing voltage.
15. Used for boiling water.
18. General symbol for a metal.
22. Frame for lattice-work.
25. Low, ill-bred fellow.
27. Suffix meaning more.
31. Destitute of the power of motion.
32. Official robes of professional men.
35. Pleasant.
37. To flow copiously.
38. Twice Three.
39. To contend.
41. To pull a vehicle.

Solution and further crossword next month

Last month's solution

A	N	T	E	N	N	A	G	A	I	N		F		
M		R		E	O	N		R		O		A		
P	R	I	M	A	R	Y	W	I	R	I	N	G		
E		O	A	R		T		T		S		I		
R	O	D	S		E	I	G	H	T	E	E	N		
A		E	K	E		M		M	I	L	E			
G		S	I	N	C	E	R	E		E	R	G		
E			N	E	O			T		V	I			
	D	O	G	M	A		E	I	L	E	E	N		
H	R	H		I	S			C	A	L		O		
	A	M	M	E	T	E	R		Y			D		
M	I	S	U	S	E	D			E			O		
	N		M		D		C	A	R	B	O	N		

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